THE NEW IRRIGATION ERA

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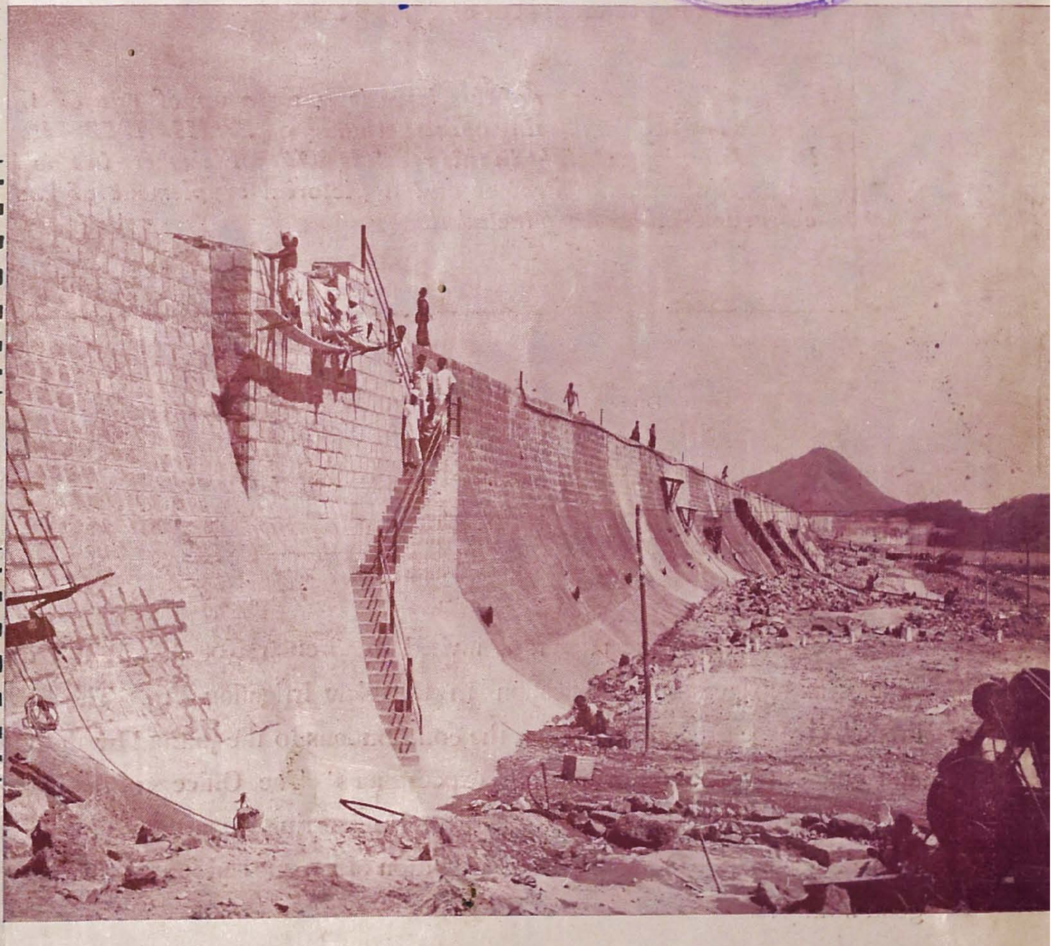

SEPTEMBER 1953-
JANUARY 1954

FOR DEPARTMENTAL CIRCULATION ONLY.

OUR FRONT COVER.

MALAMPUZHA PROJECT–MASONRY DAM SECTION.

The Malampuzha Project in Malabar District which has been initiated for tiding over the gaps between the two monsoons in a region which generally gets plentiful rainfall, comprises of a composite dam 6066 ft. in length in four masonry sections, the fifth section being in earth. The catchment area of the river at dam site is 57 sq miles. The maximum height of the Malampuzha Dam above the deepest bed is 125 ft, and the storage at F. R. L. is 8,000 M C. Ft. The spillway section is 186 ft in length and is located near the river bed and can pass a maximum flood discharge of 30,000 cusecs.

The main canal taking off from the left flank is fed from the Dam by a sluice of three vents five feet by six feet each. The canal is 20 miles long and is intended to serve an ayacut of 40,000 acres

The front cover of this issue is a close up of one of the four masonry sections of the dam during construction as on 27-11—1952. Its length is 1,915 ft. and maximum height in this reach is 60 ft. Elsewhere in this issue, an article on the Malampuzha Project and a pictorial supplement of the features of its construction have been included.

CONTRIBUTIONS INVITED.

Attention of the readers is invited to Circular No. 392/51-195 dated 26-11-1952 inviting articles and papers for publication in the New Irrigation Era. The Chief Engineer regrets that in spite of appeals and invitations, the contributions to the journal by the Officers of the Department and others have been much below expectations. The Officers of the Department, Principals of the Engineering Colleges, Officers of the Sister Engineering Departments in the State and others interested in the Science and Development of Irrigation are requested to contribute articles and papers in very good numbers.

For 'Instructions to Contributors' reference is invited to pages 245, 246, 247, 248 of Volume II. Copies may be had on writing to the Editor, Post Box No. 416, Chepauk, Triplicane, Madras-5.

THE NEW IRRIGATION ERA

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(For Departmental Circulation only)

" I believe in Hands that work,
Brains that think and
Hearts that love."

—Elbert Hubbard.

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HOW WOULD YOU DO IT?

Some of the most fascinating chapters in the life and memory of an engineer are those which deal with the unusual and unexpected situations which almost got him down but from which he finally emerged the victor.

—H. J. Gilkey.

An irrigation pressure tunnel was driven through rock of such excellent quality that it seemed unnecessary to line the tunnel. The tunnel proved adequate until unwatered when it caved in, although the rock had not softened or otherwise altered. What is the explanation?

—" Civil Engineering " November 1952

Solution to this problem will be found on page 13.

Editor's Note:—The above problem is the third of a series drawn from actual experience and designed to demonstrate how one engineer overcame one of those " bugs " with which every engineer is familiar. Such experiences are an important part of an engineer's post-collegiate education. Hoping that these problems will prove valuable to those who have never encountered them before and entertaining to those whose memories are thus drawn back to similar experiences of their own, the editor welcomes contributions to this column.

* * *

In an earlier issue of the Era *viz.*, Volume II No. 4, an article on the "Unexpected in Engineering: The Bugs " was extracted from the " Civil Engineering " of April 1952. An extract of the Addendum to this article from the same source is reproduced below for further information on the question of these " bugs ".

" Bugs " can be classified under various headings such as faulty design, major ailments, job slip-ups, fallacies of concept etc.

Three sources can be drawn upon; personal experiences of the contributors to the feature on " bugs " accumulated during their service; known experiences of fellow engineers; and more-or-less stock incidents.

This article is directed primarily toward college upper classmen and engineers in the younger bracket of experience; although it is hoped that other engineers who read the article will not deem the time altogether wasted.

(*Continued on page 4*)

HOW WOULD YOU DO IT?

(*Continued from page 2*)

In the contemplation of these incidents and situations (especially if a serious effort is made to formulate an explanation before consulting the appended discussion) it is possible for a young man to gain a better picture of some interesting aspects of engineering practice; to broaden himself and by proxy, to sharpen his engineering wits. He needs to recognize and realize at the outset, however, that these incidents are purely illustrative. An "Engineering" bug rarely bites twice in the same spot.

The incidents selected are intended to be neither the best nor the most entertaining that might have been chosen. Problems of a major and specialised nature require lot of analysis and are dealt with in elaborate articles. Hence the article on "bugs" is purposely restricted almost exclusively to relatively minor incidents representative of those which an ordinary engineer might encounter during his own routine practice.

To some, they will seem unwarrantably simple and obvious. Almost any engineer can probably counter with a better. Not the least reason for writing this series is the hope that some of the engineers who have hidden away in their own practice and contacts some really good (but true) anecdotes, may be moved to disclose them for the benefit of the rising engineering generation and the entertainment of the current one.

In view of the inexhaustible supply of suitable material available from fellow engineers, it appears that if the innovation is short lived, it will be through lack of reader interest rather than lack of copy.

If the idea takes hold, it should constitute a minor step toward the reintroduction of colour into what was once the most colourful of the professions but which has increasingly assumed an all-technical hue. The day will never arrive, however, when the practice of real engineering fails to be a method of overcoming successive obstacles, not only through the application of technical skills to the predictable but also through the exercise of horse sense, sound logic and mental agility to meet the unforeseen.

The memory of every successful engineer is replete with incidents which embodied elements of mystery and adventure—engineering romance. The best stories are yet to be written—perhaps yours is one of them.

—"*Civil Engineering*" *April 1952.*

Soil Erosion

BY SRI A. R. VENKATACHARI, B.E., M.I.E., M.AM.SOC.C.E.,
Special Chief Engineer (Irrigation), Madras.

The problem of soil erosion is an old one. Many areas which at one time were very fertile are at present barren with numerous gullies and erosions in many places in India. In the Oxford Pamphlets Series of Indian Affairs is Pamphlet No. 23 on Soil Erosion by Sir Harold Glover in which the causes, effects and remedies for soil erosion have been described in relation to the several forest areas of India with their differing local characteristics. A large amount of work has been done on soil erosion in the United States by the Soil Conservation Service under the United States Department of Agriculture. An attempt at describing in one volume the various methods adopted in various places in dealing with soil erosion in India and other countries has been made in the publication of the Government of Madras " Soil Erosion—Its Prevention and Control." This note is intended to focus attention on salient features of this problem, to describe the more important remedies to be applied wherever such erosion has caused serious damage, and to describe steps necessary to prevent erosion spreading to new areas.

Soil erosion starts whenever the soil cover consisting of vegetation of any kind or of forest is destroyed. The most effective cover for the soil is a crop closely covering the soil, a thick matty growth of grass, a heavy jungle or forest growth of trees with their roots and fallen leaves getting well mixed with the soil and forming a plastic carpet. The pressure of increasing population in search of food has been responsible for the inroads into areas already so protected by nature or by carefully executed plans of our ancestors. Once the soil cover is removed by ploughing or burning, the deterioration begins. In the wake of this destruction usually follows planting of row crops generally in a line with the slope of the land and along these rows form innumerable small drains through which water flows after a heavy rainfall cutting ditches which gradually enlarge in size. The most recent experience of this kind has been on the slopes of the Nilgiris where, due to starting of new potato cultivation on the steep hill slopes, the soil cover has been destroyed and row cropping without contour bunding has been creating new gullies and rapid washing away of the soil cover in many places. We have been trying to devise measures to stop this erosion and to prevent new areas being denuded, and brought under a regulated kind of cultivation. The immediate returns to the land owners of indiscriminate cultivation are generally good, as the soil cover is fertile, but in a few years when it is all washed off, irreparable damage ensues both to the owner and the nation. A few people who are not owners or owners lured by profits quickly made, do not pause to reflect about the consequences. The effects of destruction of the soil not felt for a few years obscure the real picture but once the damage starts, it proceeds in rapidly increasing proportions.

The methods of soil conservation which have so far been attempted are mostly those extensively tried and followed in other countries. Several of these new methods are described in the book "Soil Erosion", published by the Madras Government, already referred to. The difficulty about these works particularly in the regions which are heavily eroded is that they require a large amount of capital and co-ordination of the activities of several farmers; and where erosion has gone on unchecked for quite a long time the necessary elements for a successful reclamation are difficult to secure in practice. Even the simplest of these measures, contour bunding of fields, costs a fair amount and success depends on the owners of fields above and below a particular field co-operating and following the same methods. The cost and co-ordination of these measures are points to be kept prominently in view in dealing with this problem on a large scale among a population whose food problems are immediate and who are generally either poor or anxious to earn quick profits by cultivating virgin land and who do not join together to develop land in a scientific and co-ordinated manner.

The lands subject to soil erosion may either belong to Government as in the case of forests and porombokes or belong to farmers who are either owners or who work on leaseholds. In the former case application of remedies should be fairly easy because the State has resources to carry out works intended to check soil erosion and prevent extension of such damage to new areas. According to Sir Harold Glover most of the damage to State lands occurs by cutting away of the trees and over-grazing of the forests and poromboke lands by the enormous number of sheep and cattle in the adjacent occupied areas. It has been stated in Glover's report that India possesses more than one-quarter of the bovine population of the world most of which is of diminutive size while it possesses only one-thirtieth of the earth's land surface. In addition there are large number of goats and sheep and in most places all the available lands and pastures are heavily over-grazed. It is not unlikely that large areas of dreary wastes that we see in the Ceded Districts—Anantapur, Bellary, Cuddapah and Kurnool—of Madras State owe their present position to the unrestricted grazing of large number of goats and sheep found in those areas. There are no short cuts to the conservation of soil. Whatever the plans and measures that may finally be adopted, their execution and enforcement is of utmost importance in any scheme of soil conservation. Soil conservation has, therefore, to start with the conservation of forests and conservation of grazing and pasture lands to prevent extension of damage to new lands while remedies have to be applied to reclaim lands already affected by soil erosion. Two cheap and easy remedies which require only strict enforcement are to prevent grazing in forests and cutting down of forest growth except in accordance with a well-conceived plan of forest and pasture development. One suggestion has been made that all cattle should be fed on cut grass and should not be allowed to graze on land giving no chance for grass to grow and establish itself. Another suggestion has been made to open small areas of pasture in sets of paddocks, each set being used for grazing by rotation, after the grass has fully grown; only those paddocks on which there is a thick growth of grass should be allowed to be grazed. Where grass is cut, it should never be removed by the roots but only cut above the ground as when mowing a lawn without disturbing the soil. These measures should be adopted very rigorously and enforced by statute to preserve State forests and State lands from getting denuded of vegetation and destruction of soil cover.

Remedies applicable to private holdings are more difficult of application. There is no law at present by which the owner of a land can be compelled to treat his land in a particular manner with a view to preventing soil erosion. An owner is not likely to abandon a method of earning quick profits or satisfying his hunger except under compulsion or when the State is able to show an equally good alternative. It is no good suggesting costly or impractical remedies, and even a satisfactory but costly remedy will not be adopted without some form of State subsidy or assistance; but such remedy as is proposed by the State should not deprive him of the means of satisfying his needs by way of food. Stone dams and contour bunding are not only costly but require co-ordinated work by several farmers according to an overall plan for every little catchment unit, and will not make much of headway unless the capital and co-ordination are both secured by the State and backed by statutory authority. Its enforcement would still be difficult. Total prohibition of cultivation and plantation with grass may also be found difficult, though it is an effective remedy. Where cultivated land lies in a gently sloping country, the simplest method of preventing soil erosion is to have strip cropping, with two-thirds of the area of each field cultivated in rows parallel to the contour of the ground growing normal crops and one-third of the area being covered by a thick growth of grass which is allowed to grow luxuriantly. The row crops will provide the food and the strip crop of grass may be cut above ground and fed to the cattle. As an alternative to grass, sometimes closely growing food crops which completely cover the soil may also be substituted, but while removing them, they should not be dug by the roots. A small bund laid out along the line of these grass strips with grass for some width on the down-stream side of the bund will help to hold up rain water and pass the excess rain water gently over the bund and over the grass in rear without

damage to fields on either side of it. This is a cheap and practical remedy from the ryots' point of view and could be enforced under statutory authority. Where this experiment is tried extensively as in the United States, the stripping areas can be rotated with the cultivated areas so that there is a rotation over the whole field in a period of 3 years or more. I think this is probably the only method in which the ryots can be readily induced to co-operate without altogether abandoning their normal methods of cultivation.

Where gully erosion or sheet erosion has already started, contour bunding and check dams in the gullies followed by heavy plantation on the drain margins with possibly brushwood groynes along the course of the gully would be necessary. In cases where erosion is extensive and in private lands, some State assistance will be required by way of State loans and subsidies to reclaim the eroded lands and margins A technical service of experts in soil erosion organized very much like the Soil Conservation Service would be needed. The problems involved are more of an engineering than an agricultural character and a branch of the engineering department armed with statutory powers to enforce certain methods of control would be necessary to effectively implement these measures. It should be worked out on a quasi-commercial basis, and reclamation costs recovered in suitable instalments. A great mistake made in carrying out these measures is lack of adequate provision in the contour bunds and check dams for spillage of flood waters during heavy rains. Many such bunds and check dams are washed away in heavy rains and proper designing and execution of such works in a cheap and simple way under the advice of suitably trained engineering personnel would be necessary for effetive solution of these soil erosion problems. Field experiments will be also necessary to devise measures satisfactory for the widely varying conditions of soil, slope and rainfall.

A suitable machinery may be devised to deal with the problems of soil erosion for (a) State forests and communal pasture lands and porombokes, and (b) for private holdings left waste or cultivated by owners or on leaseholds. It is, however, essential to develop a satisfactory technique before embarking on a countrywide plan of soil conservation. Intensive and concentrated work should be done in a group of villages with limited expenditure of money to watch and compare the different methods of soil conservation both in cost and in results before launching on a more extensive programme; otherwise the schemes evolved may prove impracticable and money would have been thrown away; but what is more, failures would hold up progress. Community project areas, where some funds would be available for such purposes, should afford a good field for such developmental work.

—*With acknowledgments from the Journal of "Soil and Water Conservation in India," 1953, Vol. 1, No. 2.*

Malampuzha Project

1. Local conditions and their limitations

1.1. The Malabar District is deficient in rice and has to depend mainly on imports from other parts of this State and also the Union Government. Large irrigation projects had not been proposed hitherto mainly because the seasonal rainfall was bountiful with more than 70 to 80 inches in the driest taluks which would have been sufficient to grow a rainfed crop, if the stream flows were well distributed. In the past decade, however, failures of this crop have been occasioned due to bad distribution or failure of the monsoons, and in recent years, both the maladies have become more or less routine. The solution to the evil is simple enough. Malabar requires an irrigation project only to supplement its rainfall to a small extent in between the two monsoons and also during the closing months of the north-east monsoon (*viz.*, December and January) when dry weather prevails. Due to the small deficit that has to be made good by a storage system, the district has the advantage that with a nominal quantity of impounded water which can be supplied during times of demand, a comparatively larger area can be irrigated than under routine irrigation. Irrigation schemes in Malabar are, however, not cheap as the land to be irrigated is very undulating, sites for storage with flat terrain rarely exist, and cost of acquisition of wet lands and topes is prohibitive. The cost of storage is, therefore, comparatively higher than in any other locality.

2. Genesis of the scheme

2.1. Due to acute food shortage in the country and the difficulty of import from foreign sources, 'Grow More Food Campaign' has been launched by Government and several schemes have been inaugurated. It has been stressed that this drive should be intensified in areas where such schemes had, hitherto, not been taken up. Malabar fell under this category. There was also a lot of agitation in the district for irrigation facilities.

2.2. While projects of different kinds might be worked out in various parts of Malabar, the particular area which was badly in need of relief and where the rainfall was comparatively scarce was in the Palghat Taluk. The land here is less undulating and more favourably suited for easy and effective irrigation. Though the ryots do not normally require artificial irrigation, a small quantity of stored up water judiciously distributed during the periods of drought when supply is required to supplement rainfall will go a long way in helping them produce more foodgrains. The Malampuzha Project in Palghat taluk to satisfy these requisites was therefore, taken up for active consideration and preliminary investigation was started in 1946.

2.3. The scheme was in no way new. The first investigation was started about thirty-five years ago when a reservoir of 1082 million cubic feet capacity was considered. On account of the fillip given by the Grow More Food schemes, the Chief Engineer for Irrigation inspected the site on 27—5—'46 and after studying the rainfall records for about forty years came to the conclusion that the original capacity of 1082 Million Cubic Feet would be quite insufficient, and which if it had been adopted, would have resulted in the reservoir failing in a number of years. The storage was, therefore, tentatively fixed at 4,500 Million Cubic Feet and detailed investigation was started. The investigations were completed early in 1947 and it was intended to execute the dam in three stages.

2.4. Subsequently, however, it has been decided to complete the dam in one stage itself to impound 8,000 Million Cubic Feet and this has also been approved by Government.

3. Benefits from the scheme

3.1. In Palghat Taluk, the first crop is generally raised by broadcasting seeds, just before the commencement of the South-West Monsoon. Normally the South-West Monsoon sets in at the end of May or beginning of June. The crops mature at the end of August or beginning of September depending on the nature of Monsoon. Sometimes the South-West Monsoon stops just before the first crop is due to mature and this results in poor yield. The Malampuzha Project will assure plentiful water at this period. The

Malampuzha Project.
(Art Supplement)

Fig. 1. Panoramic view of the Dam site. The river course and the spillway portion under construction are also seen in the picture.

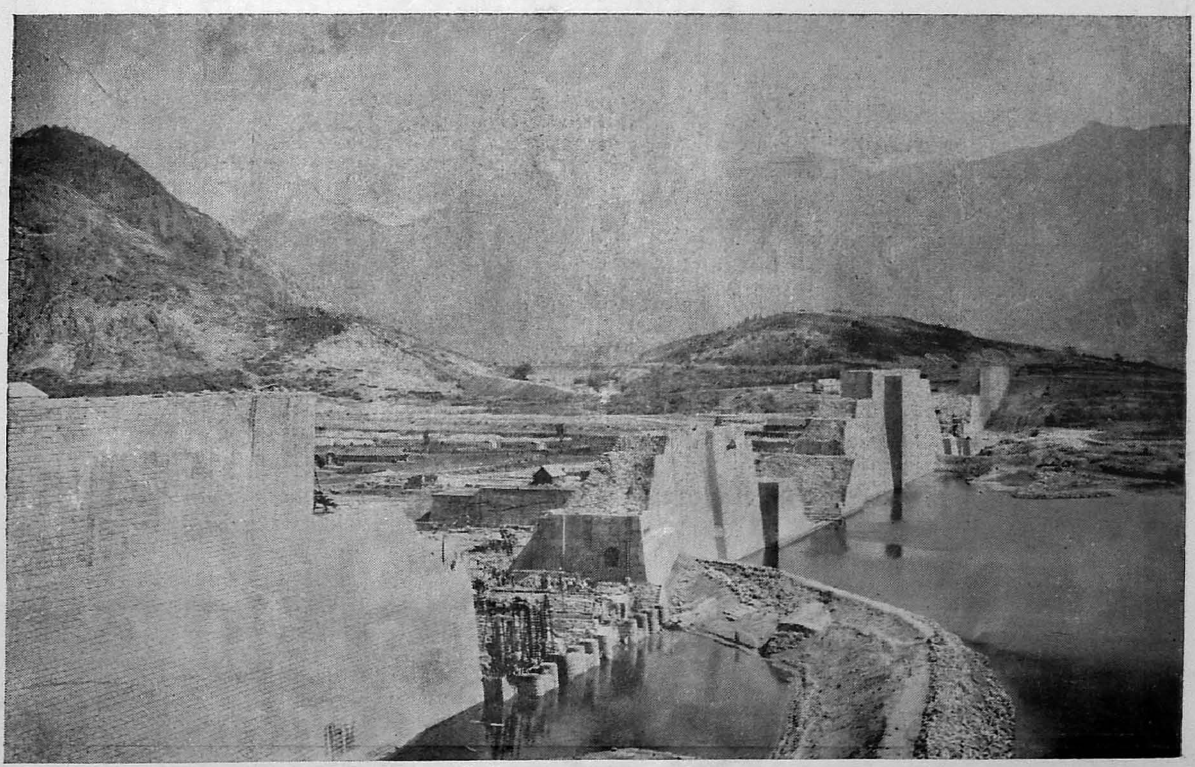


Fig. 2. Masonry Dam AB—Front view from B.

MADR

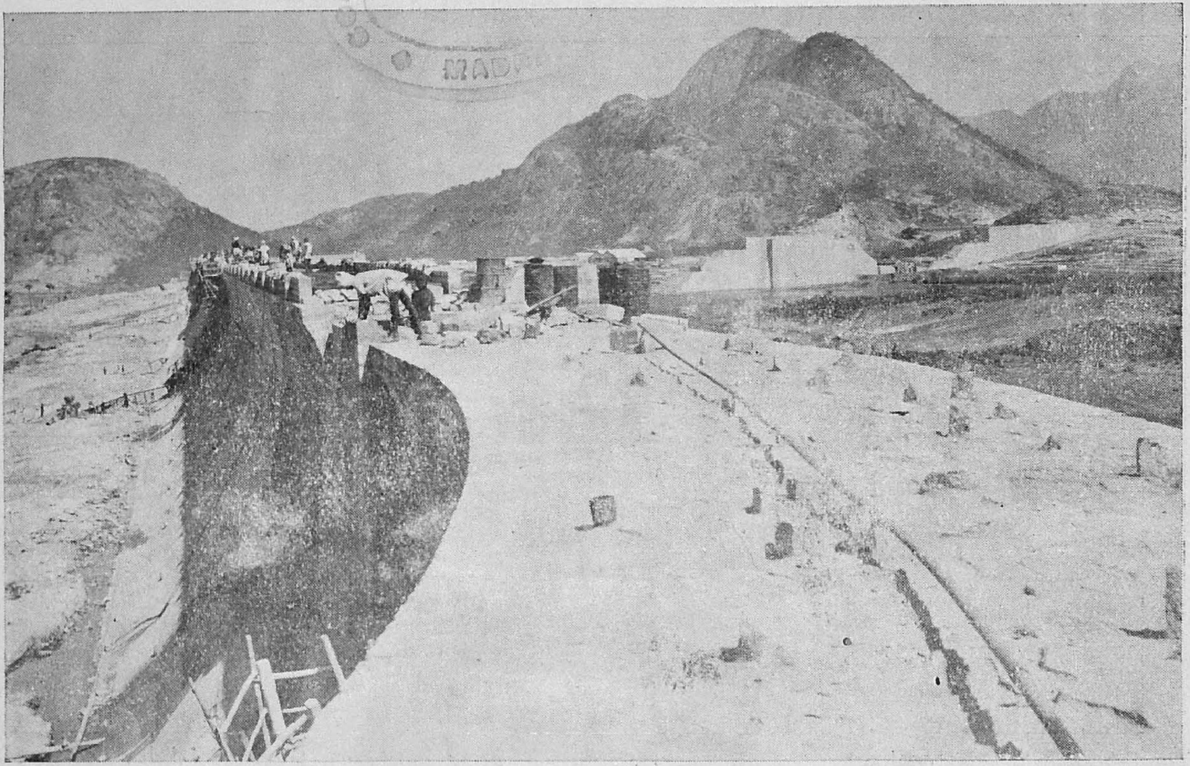


Fig. 3. Masonry Dam BX_1 from X_1— This arm is in extension of the left flank. Concreting of the roadway in progress, can be observed in the background.

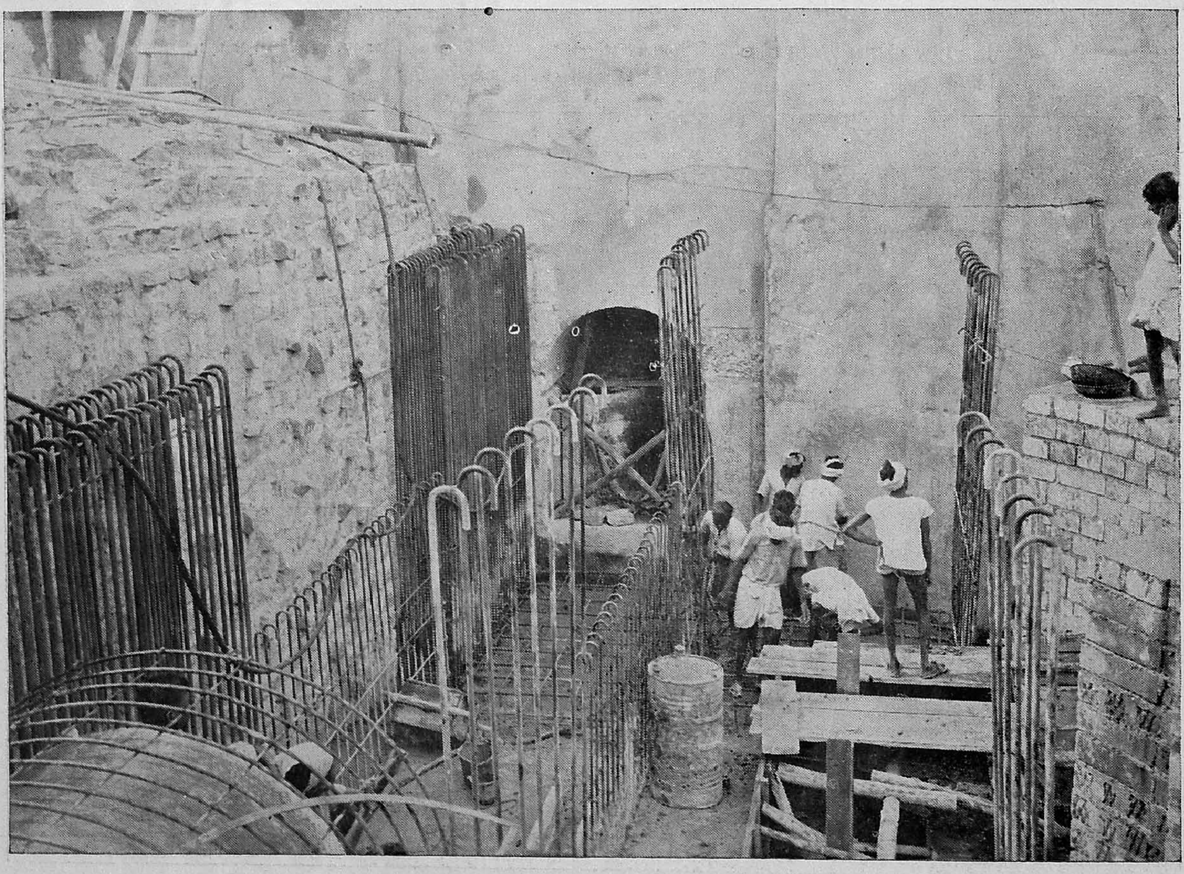


Fig. 4. Reinforcements for gallery in the left bank sluice area being fixed in situ. The completed view of the gallery can also be seen in the picture.

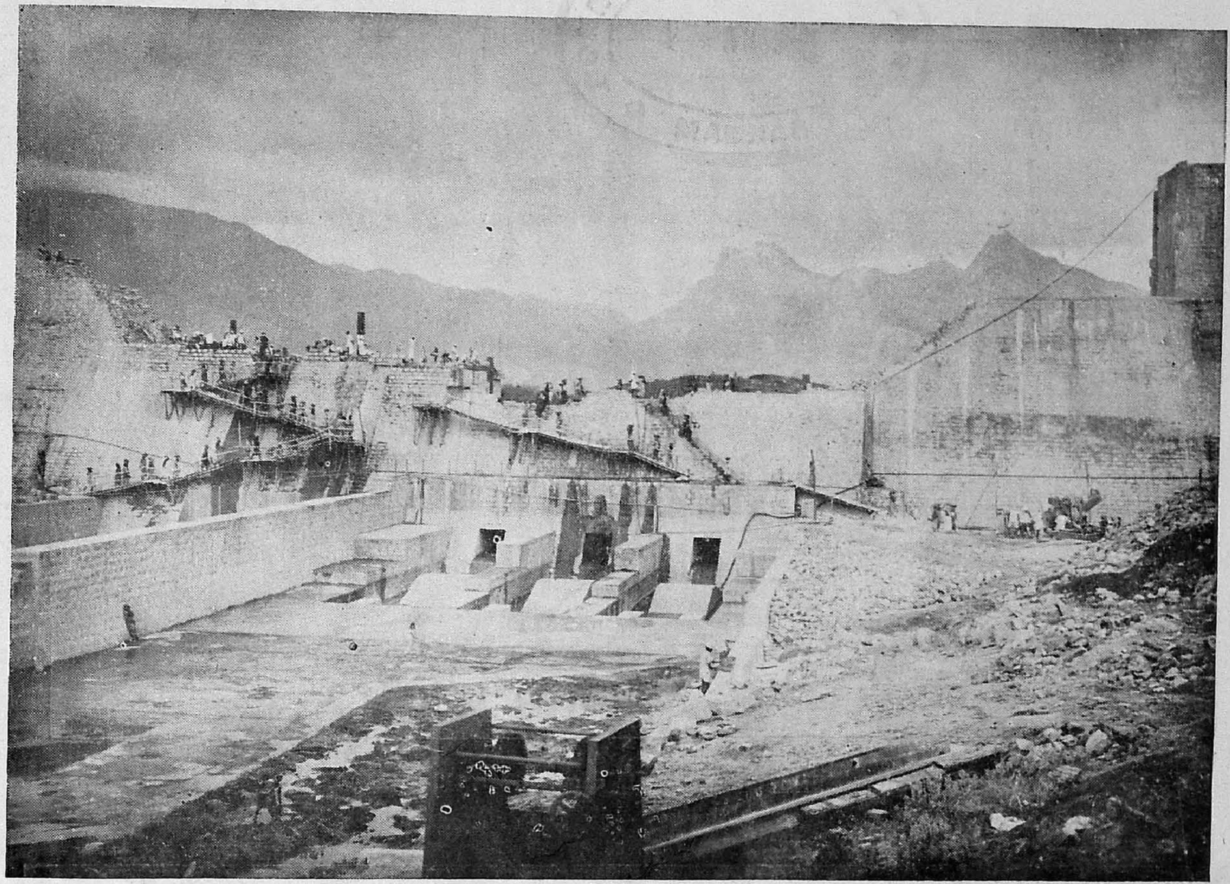


Fig. 5. Main canal sluices in the left bank. Arrangements for stilling the discharge can be observed in the picture.

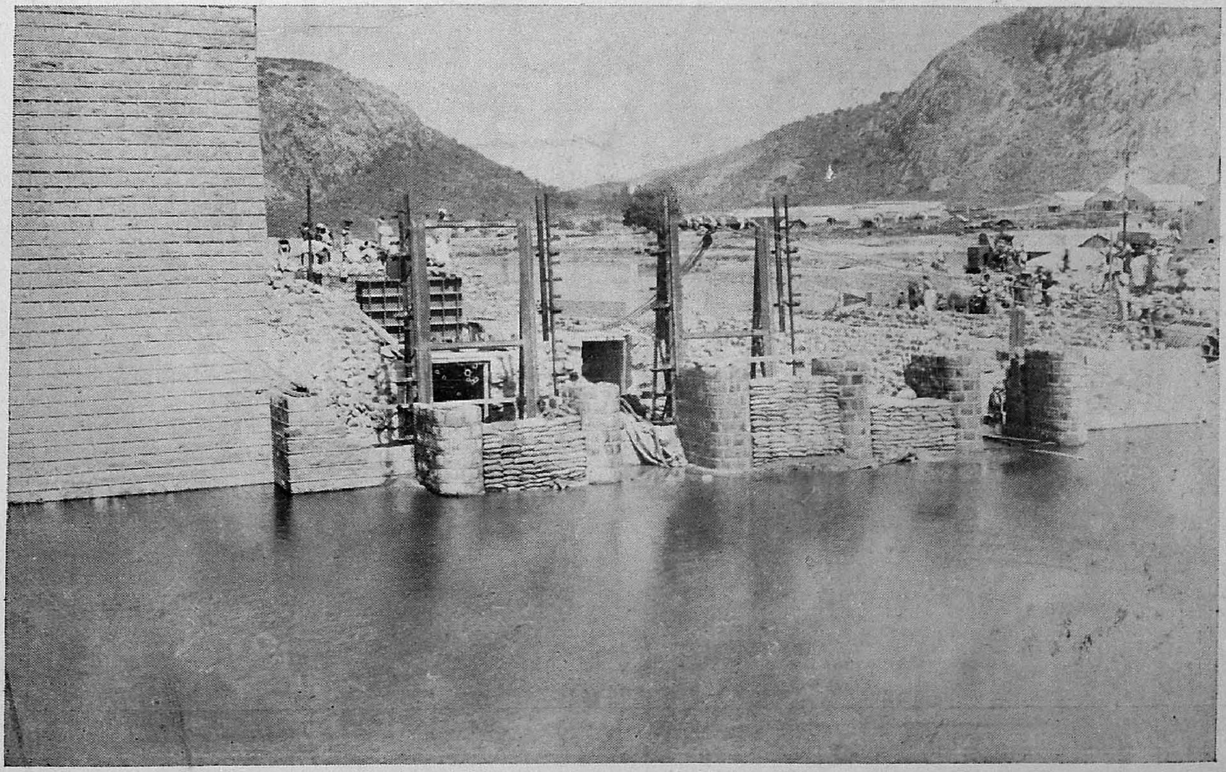


Fig. 6. Left Bank sluice and penstock blocks—Erection of frames.

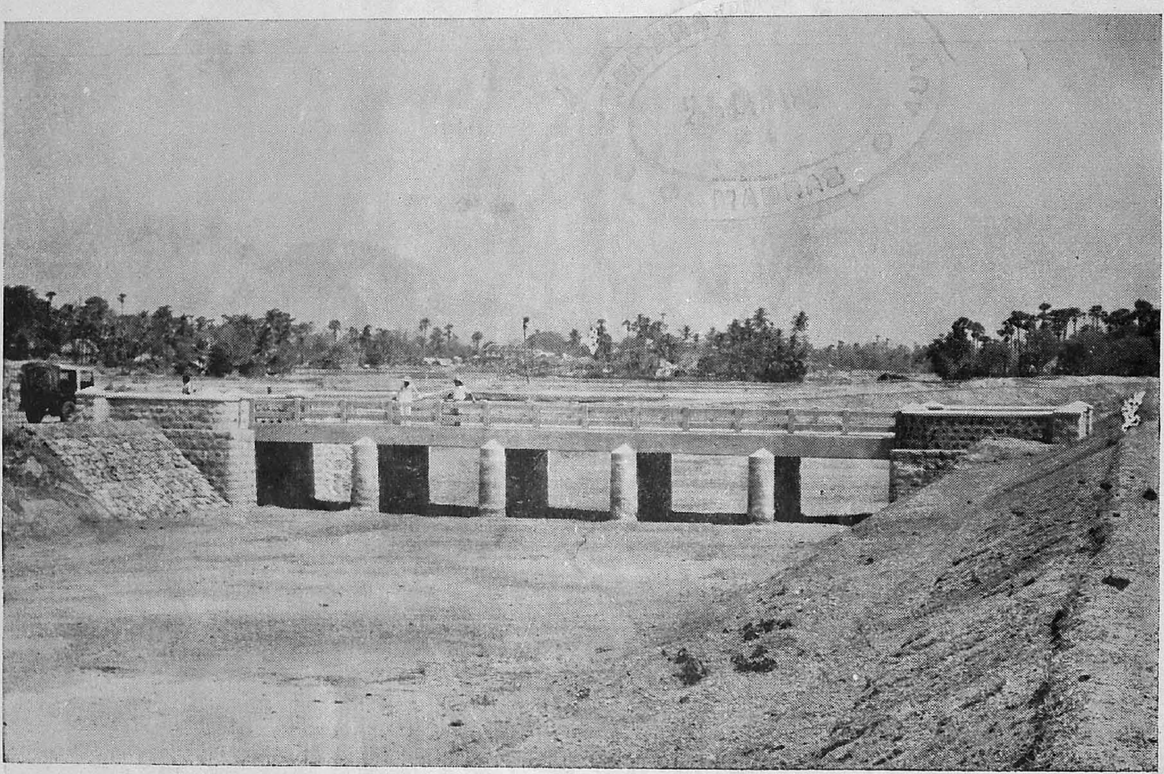


Fig. 7. Bridge across main canal at Ml. 3-6-240.

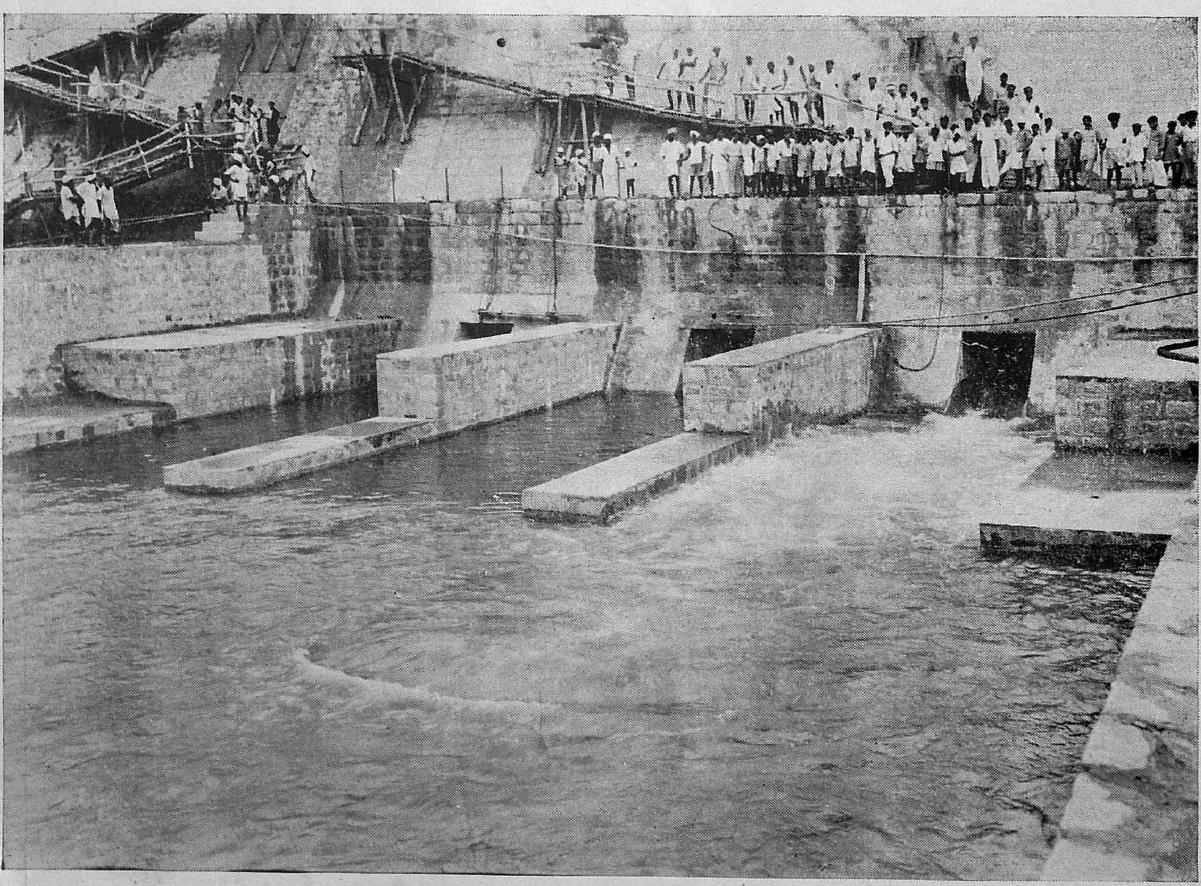
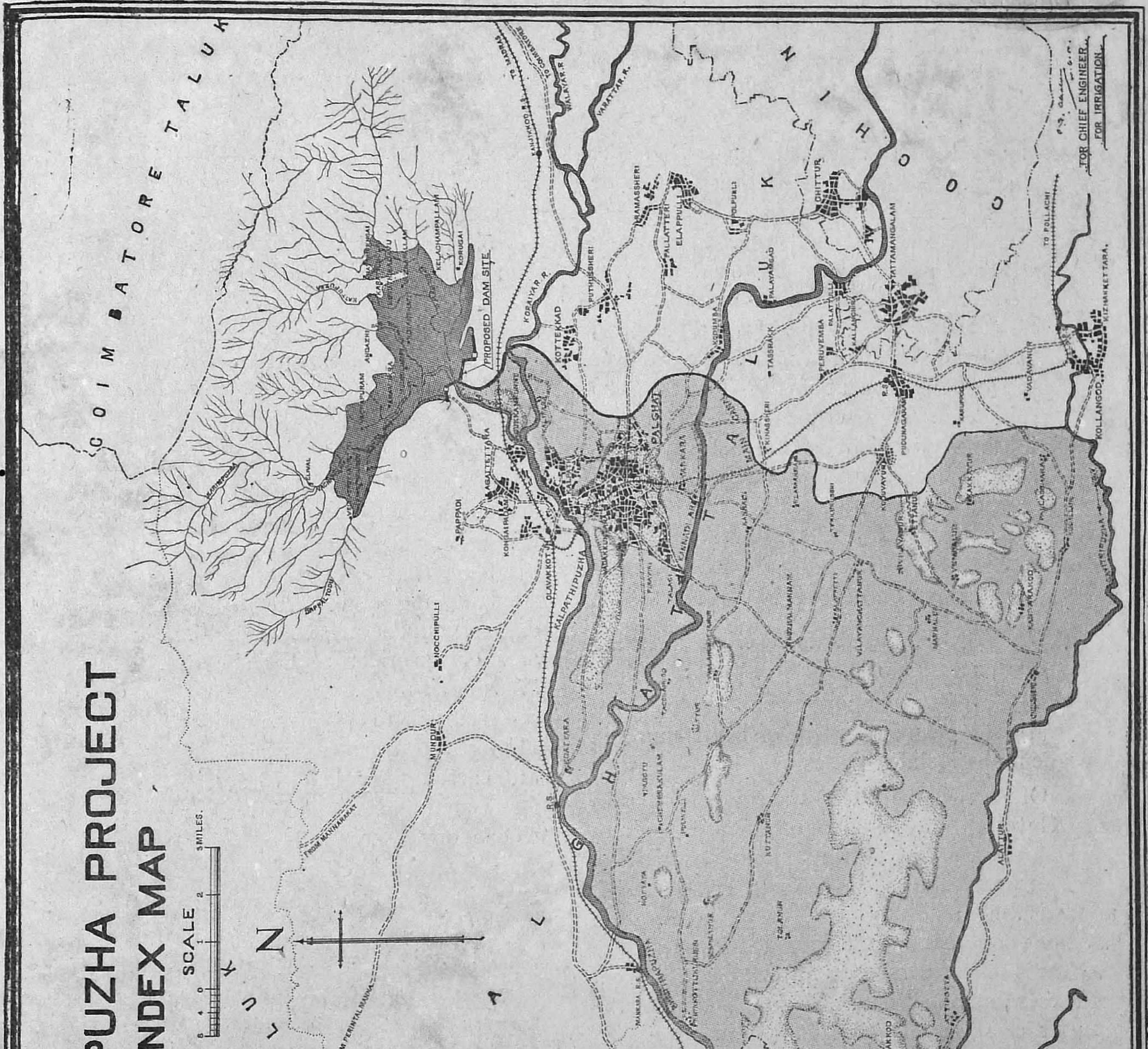


Fig. 8. Main canal sluice in the left flank with No. 1 vent discharging.
(Please see Fig. 5 for comparative study).


MALAMPUZHA PROJECT
INDEX MAP
SCALE
SMILES.
REFERENCE
AREA COMMANANDED
AREA UNCOMMANDED
RAILWAY LINE
STATE BOUNDARY
DISTRICT BOUNDARY
TALUK BOUNDARY
PALGHAT TALUK HEAD QUARTER
MAIN CANAL
COIMBATORE TALUK
WALAVANAD TALUK
PALGHAT TALUK
CHITTUR TALUK
COCHIN
COCHIN
PROPOSED DAM SITE
PALGHAT
FOR CHIEF ENGINEER
FOR IRRIGATION
TRACED BY:- R.M.RAO.

second crop for which seedlings are raised in advance, is transplanted in September immediately after the first crop is harvested. The transplantation period falls between the end of the South-West Monsoon and the beginning of the North-East Monsoon. The North-East Monsoon neither sets in at the proper time nor does it stay long enough to help in the maturing of the second crop. It is during such crisis that the Malampuzha Project will assure adequate irrigational facilities for the second crop. In a normal year, it will be possible not only to assure water for both the crops, but also to raise a third crop over about 30,000 acres. In a favourable year, there are possibilities of raising three crops over the entire designed ayacut of 40,000 acres. The annual increase in food crop will be about 10,000 to 15,000 tons of rice. Though Palghat is a surplus taluk, the increased food production will go a long way in meeting a portion of the deficit in rice production, in the northern taluks of Malabar.

4. The Inception of the Project

4.1. The difficulties that were confronting the early execution of the project were :

(i) Low return on investment.

(ii) The peculiar system of land tenure in vogue in the Malabar District.

Of the two, the latter was more serious as the Government had no rights to water courses which were, mostly under private ownership. As, normally, the cultivation was being carried on with the monsoon rain, there was no legal validity to force the cultivators to take advantage of the storage reservoir and to take water from the distribution system. The imposition of the water cess was also not valid under the then existing conditions. All these difficulties were overcome gradually by passing the necessary legislation for the levy of water cess. The estimate for the work was finally sanctioned in G. O. No. 590 P. W. dated 19-2-1949.

4.2. The project was inaugurated on the 27th March 1949 by the Minister for Public Works in the presence of a large gathering of high dignitaries and the general public. One special P. W. D. Division was formed at Coimbatore on 18-4-1949 for the execution of the work and the headquarters was later shifted to Palghat on 1-5-1949. Preliminaries were commenced immediately thereafter. As the canal works had also to be carried through along with the headworks, a second division was formed in January, 1950 with its headquarters also at Palghat. The headquarters of the original division was shifted to the site of headworks subsequently in June 1950.

5. Main Features of the Project

5. *Headworks* :—A panoramic view of the dam is shown in Figure 1*.

5.1. The Malampuzha Dam which is a composite masonry cum earthen one in five sections is being constructed across the Malampuzha river, a tributary of the Bharathapuzha at a place five miles upstream from Olavakkot. The aggregate length of the dam is 6,066 feet of which four portions are in masonry 5337 feet long and the remaining portion is in earth. The main dam and one arm in continuation of the left flank are shown in figures 2 and 3. The maximum height of the main dam above the deepest foundation is 125 feet. The catchment area of the river at the site of the dam is 57 square miles. The waterspread of the reservoir will be 9.6 square miles and will affect 111 acres of garden lands, 2648 acres of wet land, 31.06 acres of dry land, 76 acres of unassessed waste and 300 acres of river poramboke. No village or hamlet will be submerged by the reservoir. The compensation to be paid for acquiring the submergible area is estimated at Rs. 46 lakhs.

5.2.1. The masonry dam is a straight gravity type structure founded on prepared solid rock free from fissures, faults and laminations. It is divided into blocks of lengths varying from 50 feet to 90 feet by means of vertical contraction joints. Copper sealing strips fixed near the front edge of the structure effectively seal the water entering the joints. The front nine feet width of the dam is built with rich mortar 1 : 2¾ to make the structure water-tight and in the rear portion, lean mortar 1 : 4 and 1 : 5 is used. At a distance of five feet from the axis, and running along the entire length of the main dam across the river is a reinforced cement concrete drainage gallery 5′ 0″ × 7′ 6″ to collect seepages, if any, and

* Figures referred to in this article are in the art supplement.

pass it on to the rear of the dam through cross galleries built at intervals of 400 feet. A view of the drainage gallery under construction can be seen in Figure 4. On the upstreamside of the gallery, reaching up to the top of the dam are vertical drainage shafts at ten feet intervals with porous sides to collect seepages and drip them into the main gallery. In the flanks of the masonry dam, the drainage gallery is replaced by a longitudinal masonry drain with cross pipe outlets at regular intervals serving the same purpose. A roadway sixteen feet in width runs over the dam section.

5.2.2. The spillway is 186 feet in length and is located near the river bed. It will be provided with four gates of 36 feet by 15 feet to pass a maximum flood discharge of 30,000 cusecs. The masonry line on the rear of the spillway has been continued down and the designs based on Poondi Research Station experiments have been adopted for bucket, baffle wall and friction blocks.

5.2.3. The earth dam section is rolled fill of selected and moisture controlled earth with permeable and impermeable zones with impervious core. The upstream slopes of 2.5 to 1 and 3 to 1 are protected by rip-rap and the downstream slopes of 2.5 : 1 and 2 : 1 are dressed and turfed. The top width of the dam is 20 ft.

5.2.4. Typical sections of the gravity, spillway and earth dam portions are given in Appendices I and II to this article.

5.3.1. The main irrigation sluice with three vents 5 feet × 6 feet is located at the left flank of the main arm of the dam (Figure 5). Another sluice with a single vent five feet by six feet is situated in the right flank in order to provide for irrigation of 300 acres of lands on this side of the river which were being previously fed from an old anicut above the dam. This sluice can also cater for future development. Adjoining this sluice, pipes 18 inches in diameter are embedded in the dam for drawing water for the water supply of Palghat town.

5.3.2. An unique feature of the Project is that all the Cast Iron linings, sluice gates, hoisting arrangements etc., required for the irrigation sluices were all designed and fabricated in Public Works Workshops at Madras and conveyed to the workspot. Figure 6 shows sluice linings being fixed.

5.3.3. Provision has been made for generation of power from the dam at a future date. For this purpose, two penstock pipes six feet diameter, fabricated in the Public Works Workshops, Madras, have been built in the dam adjacent to the irrigation sluice. Provision has been made for the tail water for power generation to be discharged into the main canal and utilised for irrigation purposes or to be surplussed into the river.

5.4. *Attendant Works :—*

5.4.1. Buildings have been put up for and occupied by all the staff employed in the Headworks. Provision has been made to accommodate 219 officers and subordinates and 504 tenements have been built for the mazdoors. There is a circuit house fully furnished and equipped, a Hospital, a Post Office, an Elementary School and a Police Outpost. The well-laid out colony is provided with electric lights, protected water supply and modern sanitation.

5.4.2. The road from Olavakkot which has to be frequently used for transport of materials, haulage of equipment etc. has been taken over by the Department from the concerned authorities *viz.*, the Palghat Municipality and Malabar District Board. It has been widened and improved and maintained to standards in the interests of works, the total cost being debited to the Project.

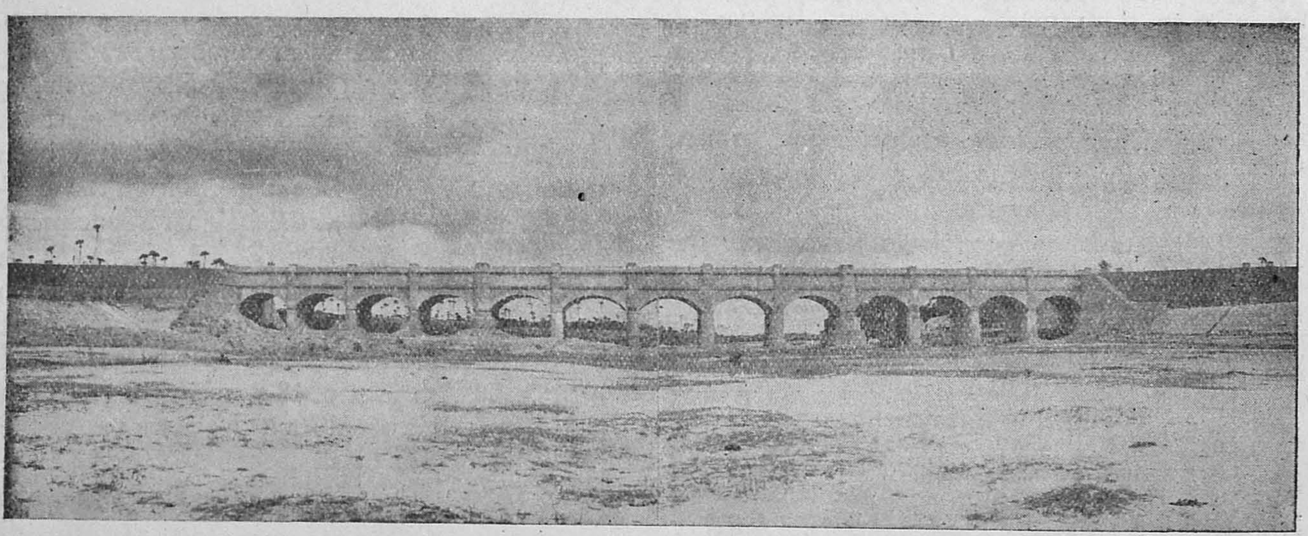
5.4.3. A bridge of 18 spans of 12 feet each has been constructed below the dam for the transport of materials to the left flank of the river. A workshop has also been rigged up at site and is equipped for attending to repairs of machinery used on works. A Test Laboratory is regularly conducting tests on materials and is controlling the quality of work done on the dam.

6. Distribution Works

6.1. *Main Canal* :— The main canal taking off from the irrigation sluices referred to already, will be about twenty miles long and will run in a north-south direction irrigating lands on its right side by sluices located in the right bank and also through a series of distributaries running in a east-west direction. The main canal has a bed width, at commencement, of 60 ft. with a capacity of 750 cusecs at a full supply depth of 5 ft. (A view of the main canal and a bridge at mile 3–6–240 is given in Figure 7). The width and depth of the canal

gradually get reduced and it ultimately tails into the Gayatri River. In times of need the surplus water from the Malampuzha Reservoir can irrigate about 3000 acres under the Gayatri River.

6.2. *Cross Masonry Works* :— There are two major aqueducts in the canal, one across the Korayar river at the first mile, seventh furlong and the other across the Kannadi river at the seventh mile, seventh furlong. The Korayar aqueduct consists of a trough of size 25'-6" x 6'-0" taken over masonry arches of 30 ft. span with precast concrete blocks. Open foundations have been adopted for Korayar Aqueduct. The Kannadi Aqueduct consists of a trough of size 22'–6" x 6'–0" taken over masonry arches of 30 ft. span. Well foundations were found necessary for this structure. A view of Kannadi aqueduct is given below.



Kannadi Aqueduct

Besides these there is a pressure aqueduct across the Erumayur thodu at mile 15–4–216 of the canal. It is of R. C. Box type of size 5'–0" x 5'–6" taken over masonry piers built in the deepest portion of the thodu.

6.3. *Distributary System* :— The distributary system consists of a series of distributaries or channels totalling about 110 miles in length. These channels will feed field bothies of an aggregate length of over 200 miles.

7. Progress

7.1. *Headworks*:—The work on the masonry of the dam was started in September 1950. Work has almost been completed in three out of the five sections of the dam. In the aggregate, about 85 per cent of the total works on the dam has been completed so far. The dam was originally programmed to be completed by the end of 1953. But due to sudden reduction in allotment of funds during the year 1952, the best portion of one working season was lost. As a result of this, the completion of the dam has been postponed by a year.

7.2. *Canals* :— Work in the canal system was commenced in 1950. About 85 per cent of work in the main canal has been executed so far and the balance is expected to be completed by 1954.

7.3. About 50 per cent of work in the distributary system has been completed so far and it is expected that most of the works will be over by the end of 1954.

8. Expenditure

The total expenditure incurred on the project for the works completed so far to end of August 1953, comes to Rs. 152 lakhs for Headworks, Rs. 116 lakhs for Canals including distributaries totalling to Rs. 268 lakhs against the sanction of Rs. 380 lakhs for the complete work.

9. Special Features

The major portion of the dam has been built of stone in cement mortar, granite stones and sand of good quality being available near the site of the dam. When the dam is completed, it would have consumed 70,000 tons of cement which has been supplied entirely by

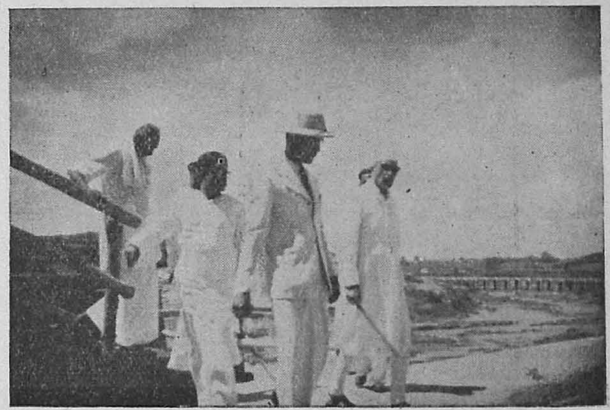
the A.C.C. Factory at Madhukkarai. The labour employed during the peak period was about 5,000 a major portion of which was drawn from the adjoining district of Coimbatore. It can be safely asserted that the dam has been built mainly by manual labour limiting machinery to the barest minimum. Works were carried out on the job work system, the commitments being normally limited to Rs. 25,000 at a time.

10. Conclusion

10.1. The canal sluice was opened for testing purposes on 11–9–1953 and Figure No. 8 shows it functioning.

These sluices were subsequently thrown open for irrigation on 2–10–53 and water was let in the canal to benefit an ayacut of 5,000 acres in the first twelve miles of the canal.

10.2. The Malampuzha Project was inspected by the Prime Minister of India on 4–10–53 and a snap taken on this occasion is reproduced below.



(*For appendices I & II, vide pages 14 and 15.*)

HOW WOULD YOU DO IT?

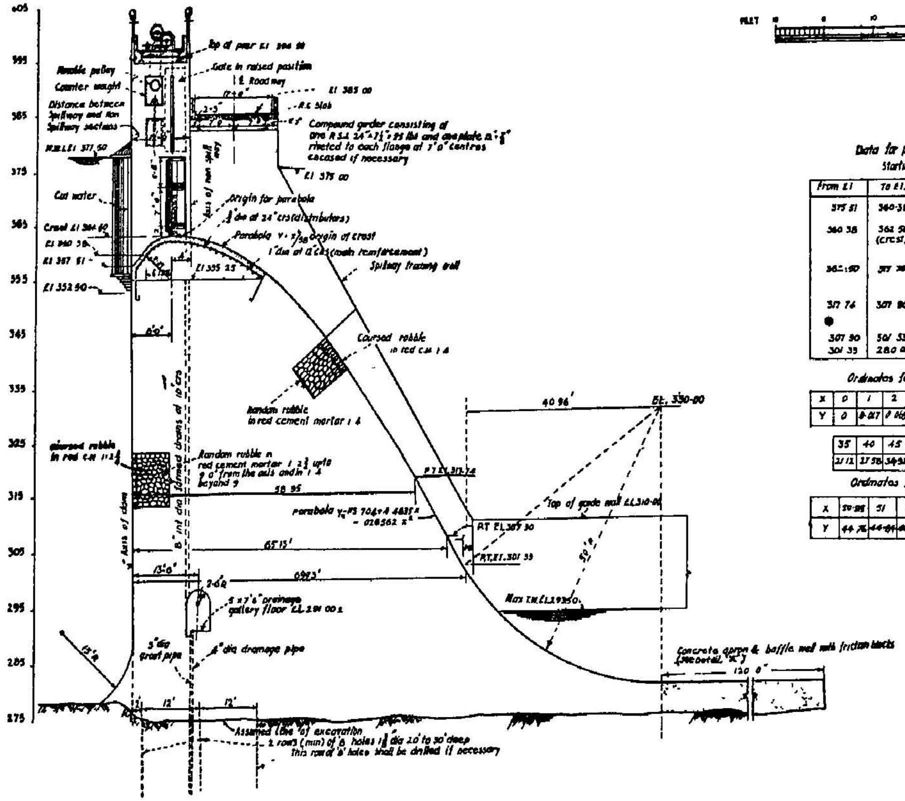
Solution to Problem on Page 2.

Water, under high pressure, has been forced back into the seams and interstices of the rock. With the quick release of pressure when the tunnel was emptied, the water thus stored functioned as one continuous charge of slow blasting powder. The action was analogous to that which may burst the ear drums or produce "the bends" in the human system following too rapid a transition from low to high, or from high to low pressure.

MALAMPUZHA DAM

SPILLWAY AND NONSPILLWAY SECTIONS

ARM. AB



SPILLWAY SECTION
ARM. AB

Data for plotting Spillway profile
Starting from axis of dam

From El	To El.	Profile
375 51	360·38	slope 1:1
360 38	362 50 (crest)	Arc of a circle of 7 25 Radius (Based on U S B.R practice and modified by Poona Research Station)
362·50	317 74	Parabola y = x²/58 with origin at crest (1 trajectory)
317 74	307 90	Parabola y = −113 704 + 4 4635 x − 026562 x² (origin of crest)
307 90	301 33	slope 7 to 10
301 33	280 00	Arc of circle 50' radius

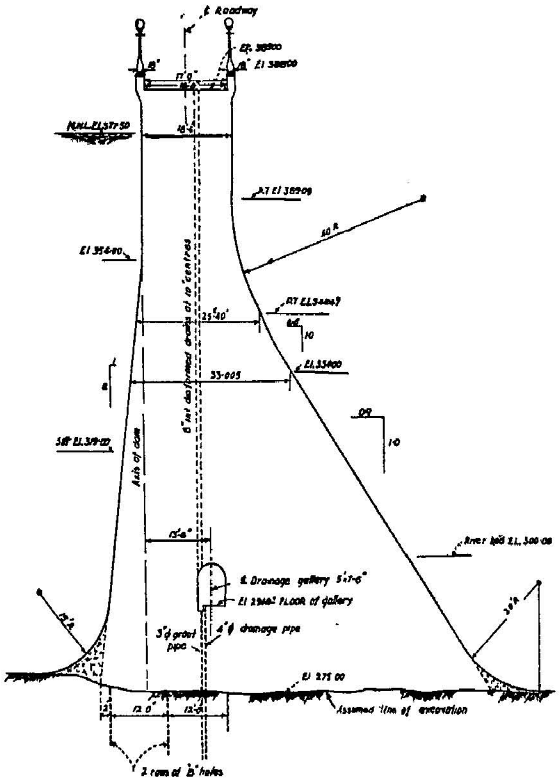
Ordinates for parabola $y = x^2/58$

X	0	1	2	4	8	10	12	14	15	20	25	30
Y	0	0·027	0 069	0·276	1·10	1 72	2·48	3·38	3·88	6·90	10·77	15·52

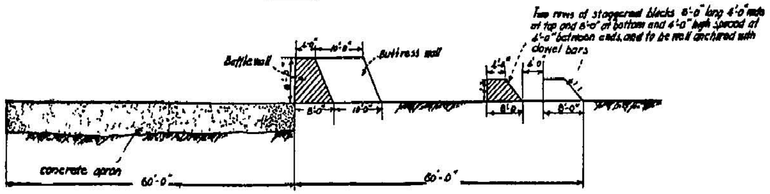
35	40	45	50	52 85
21 12	27 58	34·91	43·1	44 76

Ordinates for parabola y = −113 704 + 4 4635 x − 026562 x² (origin of crest)

X	50·85	51	52	53	54	55	56	57	57·43
Y	44 76	44·84	46 57	48·25	49·86	51·44	52·95	54 41	54·64

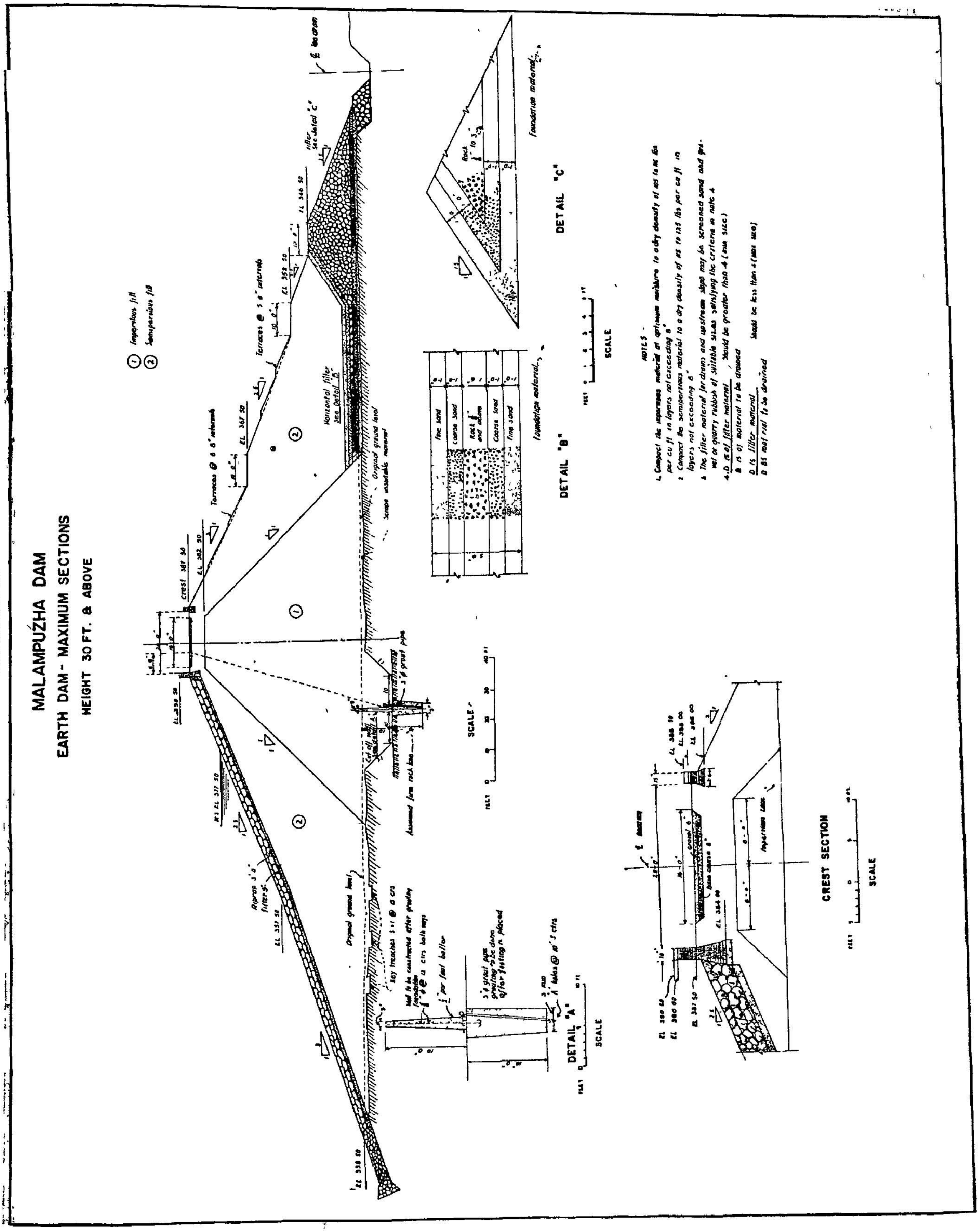


NONSPILLWAY SECTION
ARM AB



DETAIL X

APPENDIX II.


MALAMPUZHA DAM
EARTH DAM - MAXIMUM SECTIONS
HEIGHT 30 FT. & ABOVE
DETAIL "A"
DETAIL "B"
DETAIL "C"
CREST SECTION
SCALE
NOTES

Progress of Research Work in Madras.

[*Note* :— This is the last of the series on the Progress of Research Work in Madras. In the previous numbers the activities of the Irrigation Research Station at Poondi and Soil Research Station at Chepauk were recounted.

In this and the forthcoming issues, the works handled by the Central Designs Office and the Concrete Laboratory will be dealt with.

The first article in this series by the Designs Engineer, deals with the functions of the Central Designs Office.]

C. I. CENTRAL DESIGNS OFFICE, CHEPAUK.

1. *Introduction* :— The Central Designs Office consists of a Designs section, a Concrete Laboratory and a Building Research Unit. It is proposed to deal in this article with the organisation of the Designs section and one phase of its activities *viz.*, " Standardised Drafting Procedure."

2.1. *Necessity and origin* :— For a long time past, the Buildings Branch of the Madras P.W.D., has been having a separate specialised designs section in the Consulting Architect's Section, but the Irrigation Branch had no such set up till 1946. Prior to that, there had not been many major dam structures in the State except Periyar and Mettur. These projects had a separate Engineer-in-Chief or a Superintending Engineer who had the designs prepared in his own technical section. The preliminary project investigation plans for these projects were generally far more complete than those that are being sent now due perhaps to the protracted nature of investigations. As such, no separate organisation for designs appears to have been found necessary then.

2.2. However, during the latter part of the second World War and thereafter, a large number of major irrigation and smaller G.M.F. schemes had to be taken up urgently to meet the acute food shortage situation. Consequently, the investigation of these schemes had to be carried out expeditiously with the available staff who were mostly fresh from the College and had therefore not gained enough experience to tackle these works. Hence the preliminary designs, though good enough for preparing the project estimates required considerable revision when the projects actually came up for execution.

2.3. Thus, with the increase in the number of major projects designed to harness the unutilized waters of major rivers like the Godavari, Kistna and the large number of smaller projects connected with the G. M. F. drive, it became necessary to expedite the designs of the projects so that the execution may not be held up for want of the same. Also the drawing offices of the Project Engineers, do not generally have the opportunity or time to get acquainted with the recent trends in modern technique of design of hydraulic structures and their allied works. These Engineers have enough of work to do in dealing with the technical works of a routine nature such as for example, the scrutiny and sanction of estimates, making out indents for materials and attending to the day to day details to be handled by them. It was also found necessary to keep the field Engineers free from the arduous work of designs so that they could concentrate on the execution side and thus ensure speed, economy and high standard of work.

2.4. The Madras Electricity Department which took up earlier a large number of Hydro-Electric Projects like the Pykara, Papanasam, Machkund etc., has been for quite a number of years, running a separate technical office where they have centralized all their designs with very great advantage.

2.5.1. Under these circumstances, the formation of a Centralised Designs Branch was necessitated in order to evolve the most scientific, practical, cheap and locally suitable standardised designs for the different project structures incorporating in them the latest techniques on design practised in India and abroad and also by co-ordinating the results of

the research work carried on with representative models and samples.

2.5.2. One of the phases of " Standardisation " is "the drafting procedure" which is dealt with as an Annexure to this article. Other features involving designs etc., will be dealt with in subsequent papers.

3.1.1. *Formation of the Designs Office and its working* :— Thus, when the Ramapadasagar Project was investigated, a Designs and Tests Division was sanctioned in 1946 for works primarily connected with that project. Ramapadasagar dam presented complex foundation problems having very few precedents and the preliminary plans prepared here were therefore subsequently finalised by the International Engineering Co., U.S.A., under the direction of Dr. Savage; Dr. K. L. Rao, the then Designs Engineer with a skeleton staff was also deputed to U.S.A. in this connection and was associated with this work.

3.1.2. In 1949, when the Ramapadasagar Dam design work was slowed down, the Designs and Test division was converted into a Central Designs Office to deal with the preparation of designs and specifications of Lower Bhavani, Malampuzha and Tungabhadra Dams which had then been taken up for execution.

3.1.3. The staff then comprised of a Designs Engineer of the rank of a Superintending Engineer, with five Assistant Engineers, one Mathematical Assistant and twelve Supervisors with necessary drawing office staff.

3.1.4. When, however, the Kistna Pennar Project designs were taken up early in 1950, the staff was strengthened by the addition of an Executive Engineer, an Assistant Engineer, six Supervisors and complimentary drawing branch staff.

3.2.1. The designs of the following projects and works have been dealt with in this office ever since its inception :—

(1) Ramapadasagar Dam.
(2) Lower Bhavani Dam.
(3) Malampuzha Dam.
(4) Tungabhadra Dam.
(5) Kistna Dam.
(6) Pennar Dam.
(7) New Gandikota Dam.
(8) Rallapad Dam.
(9) Manimuthar Dam.
(10) Upper Pennar Project.
(11) Pulichintala Project.
(12) Nandikonda Project.
(13) Aranıar Project.
(14) Mettur Canals.
(15) Kistna Regulator and Bridge.

3.2.2. In the case of Tungabhadra Dam, it was a joint venture of Madras and Hyderabad States, so that the designs also had to be prepared jointly. For this purpose, an Executive Engineer with two Assistants was deputed by the Hyderabad State to this Central Designs Office, to work out the designs for their reach of the dam in collaboration with us.

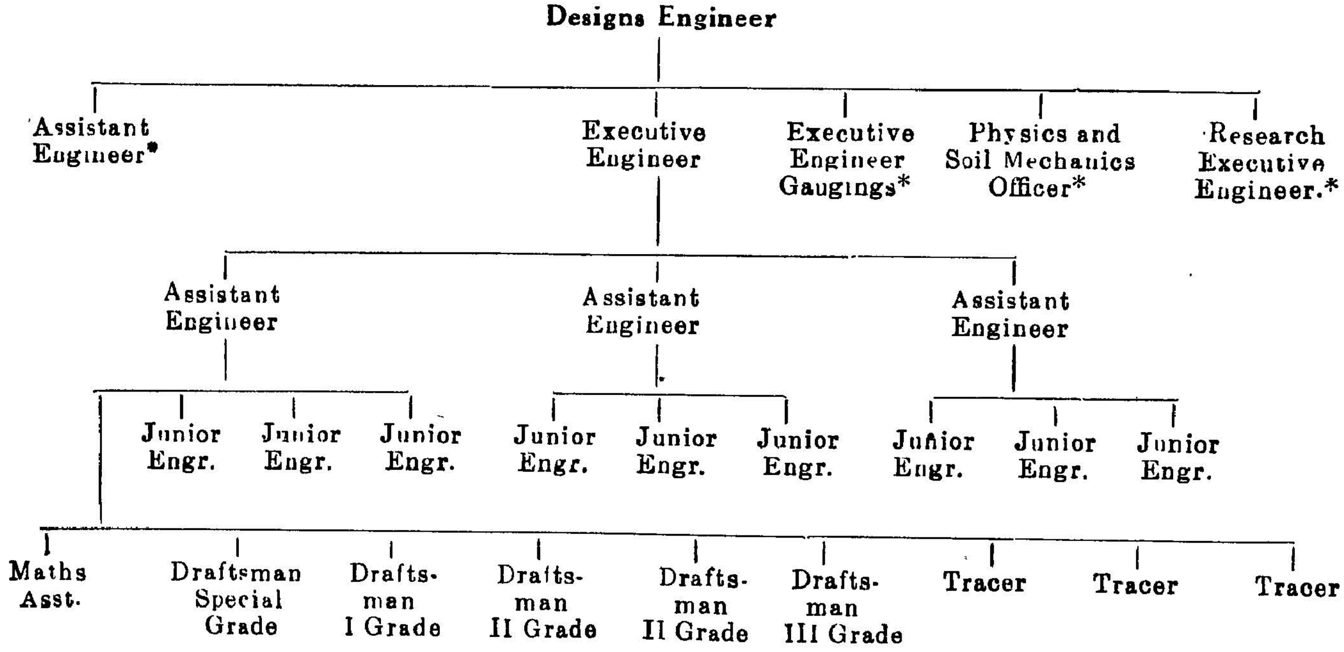
3.2.3. Though the Central Designs Office has mainly been entrusted with the designs connected with the Headworks of Projects, major structures in Canals system have also come up for design namely Kannadi and Korayar aqueducts and Erumayurthodu crossing in the Malampuzha Canals System, Cauvery aqueduct, Chittar and Sarabanga Nadhi crossings of the Mettur Canals System.

4.1. With the partition of the Andhra State, we are now left with the designs work pertaining to Manimuthar, Walayar, Mangalam and Araniar Projects which are under execution. The Vaigai and Amaravathi schemes have to be taken for execution immediately. Future projects like the Kanihirapuzha and Sathanur are also likely to come up for sanction in the near future. There are also a large number of comparatively smaller projects for which preliminary investigation has been done in the Residuary State and these will have also to be taken up in due course to aim at making the State self-sufficient in the matter of food. All these would necessitate detailed designs, specifications etc. being prepared in this office.

4.2. The scope of the works to be handled in respect of the above programme would be :—
(1) Preparation of Designs, Specifications and technical memoranda for the projects that will come up for execution in future. (2) Apart from this, preparation of standard type designs for various component works in the Headworks and Canals system will form an important item of future work. It has not been possible to take up this work so far, as this office has been fully preoccupied with the preparation of designs mainly for projects under execution.

4.3.1. *staff*:—The organisation chart of the Central Designs Office is given below:—

CENTRAL DESIGNS WING
DESIGNS WING
ORGANISATION CHART



* These do not form part of the Designs Wing and they denote establishment under branches other than Designs which are also under the control of the Designs Engineer and whose activities form part of separate articles some of which have been published already.

4.3.2. The Central Designs Office has been working under the guidance and control of the following Chief Engineers:

1. Sri N. Govindaraja Iyengar,
2. „ A. R. Venkatachari,
3. „ M. S. Thirumale Iyengar,
4. „ T. S. Venkatarama Ayyar,
5. „ L. Venkatakrishna Ayyar, and
6. „ N. Padmanabha Ayyar.

4.3.3. The successive Designs Engineers who have been connected with the organisation are:—

1. Dr. K. L. Rao,
2. Sri J. M. Fredrick,
3. „ K. Harihara Ayyar, and
4. „ K. V. Ekambaram.

4.3.4. The Executive Engineer-in-charge of the Designs is, Sri S. Raghavachari.

5.1. *Conclusion*:— The Designs Office organisation has grown up from modest beginning and is now in the nature of a consulting authority on all major, technical problems. It is also the basic office from which detailed designs for all projects issue forth.

5.2. With the works already on hand and those that are likely to come up in the future, the necessity for this Central Designs Office as a permanent organisation is well established. No doubt, a nucleus staff will have to be permanent and additions made to it as and when required to deal with the increased work.

ANNEXURE

Drafting Standards

1.1. *General*:— The drafting procedure which is in vogue at the Central Designs Office aims at standardizing the preparation of drawings and securing the greatest possible uniformity in appearance, size and style.

1.2. As a drawing is a means of conveying and recording information, the information furnished on the drawings should be not only correct but should also be so arranged and referenced as to enable the drawing or map to be followed easily and interpreted clearly. Initial drawings are prepared on section sheets with all

lines made out in pencil in a clear and sharp manner. Finished drawings are traced out from them to standards which would admit of prints or reproductions as well as reductions to the smaller scales commonly in use being taken out from it clearly and legibly. Careful consideration should also be given to the accuracy, style and position of all notations. The lettering should also be simple and notes should be limited only to those required for accurate interpretation. A typical illustration of a standardised drawing may be found in any one of the printed specifications and drawings prepared in the Central Designs Office.

2. *Preparation of drawings and tracings* :—

2.1. *Orientation* :—The orientation of drawings should be in accordance with the following principles :—

2.1.1. Location maps, vicinity maps and all similar maps should generally be oriented with the north to the top of the page. The orientation may however be changed in certain special cases, when the area to be mapped is of such a nature that conformity with this rule would result in a lot of unnecessary blank space in the map. In such cases, true meridians should be shown by full headed arrows of single but distinctive lines.

2.1.2. Detailed maps, plans and layout drawings for dams, reservoirs and other major structures should be oriented so that the direction of stream flow is towards the top or the right side of the sheet. A north point arrow should be placed on all such drawings and a stream line arrow should be included whenever applicable.

3. *Drawing sizes* :— *Sizes of drawings* :—

3.1. A standard overall size for all regular specification drawings of 40" X 22" with the marginal line or border half an inch from the outer edge at the top, bottom and right sides and 2" at the left side is preferred for the following reasons.

3.1.1. The width of all section sheets is 22" which is the same as the height selected. Though the stock size of the section sheets is 30"×22" an additional length can be obtained by adding a bit 10" long to the stock size to bring it up to the size of standard sheet.

3.1.2. The widths of the rolls of tracing cloth supplied to this Department are 24", 30", 36" and 42". Out of these, tracing cloth of 24" and 42" width are eminently suitable for cutting out standard sheets with practically no wastage as indicated in figures 1 and 2.

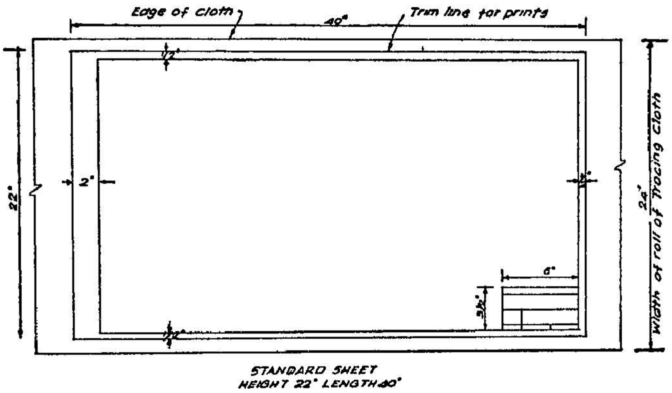


Figure 1.

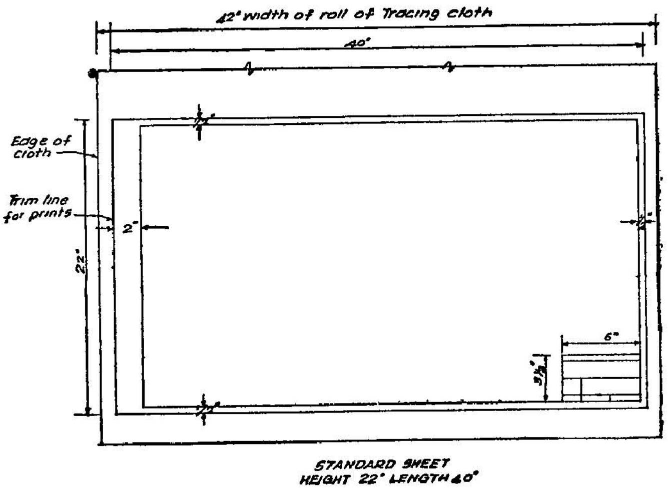


Figure 2.

3.1.3. The manner of cutting a standard size sheet of tracing cloth from stock sizes is also indicated in these figures.

4. *Scale of drawings* :—

4.1. Graphic scales should be shown on all drawings. Standard form of graphic scales are shown in figure 3. Indicating the scales in words which has been the practice in vogue, so far, will not be representative as very often the original drawings have to be enlarged or reduced by

photographic process in which case the scale in words will indicate wrong dimensions. The most suitable location for indicating the graphic or diagrammatic representation of the scale will be a little above the title block. The scale for

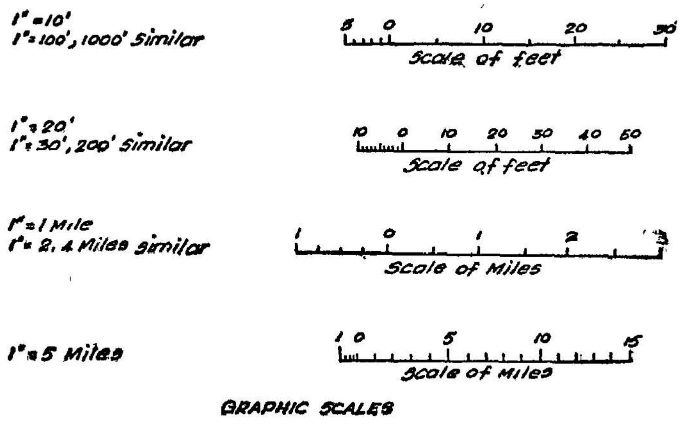


Figure 3.

the main view in the drawing will be just above the title block while scales for other views could be shown under the respective views.

4.2. *Graphs*:—The main grid lines and sub-divisions of the grid may be omitted only in the rectangular space intended for legend, notes etc. as illustrated in figure 4. For convenience in reading the values, it will be

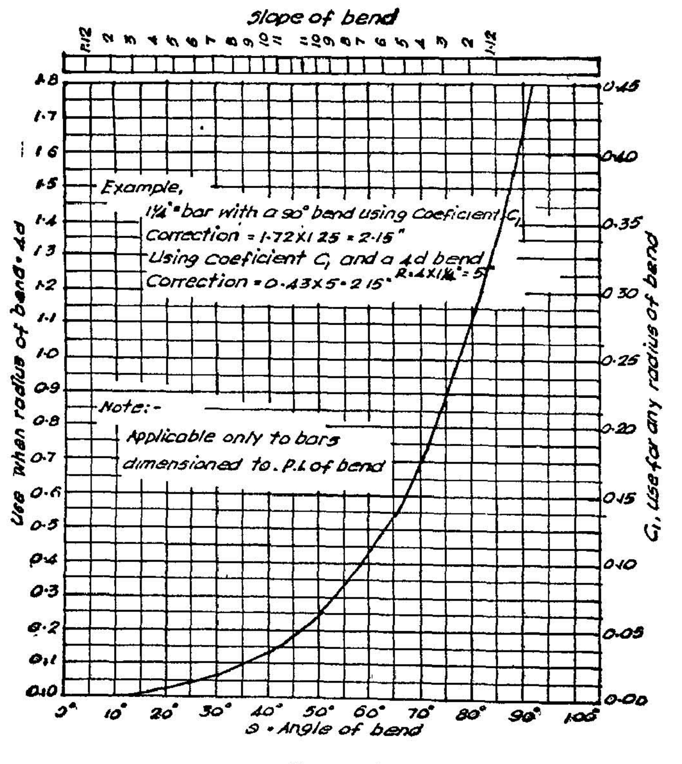


Figure 4.

advantageous if the grid lines and sub-divisions of the grid are marked from the axes.

5. *Lettering*:—Lettering should be plain, single and free from adornment and should be legible. Sloping types of letters and numerals are adopted in the drawings as they are easier and quicker to write and present a pleasing appearance. Recommended sizes of letters to suit different purposes are indicated in figure 5.

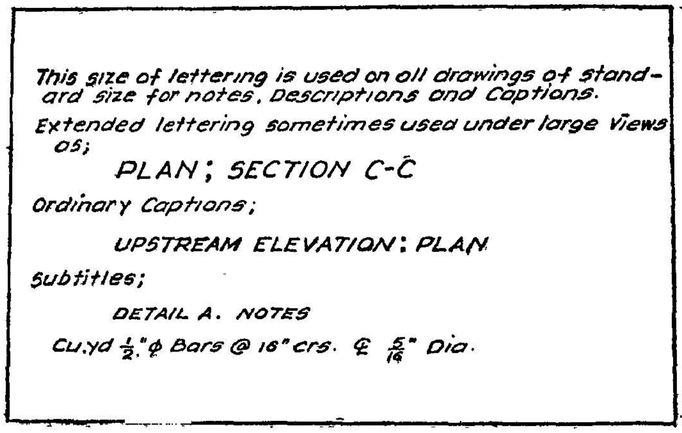


Figure 5.

6. Titles of drawings are shown in the standard title blocks in the bottom right hand corner of each drawing. The height and width of the title block used in this office are 3½" and 6" respectively. The lettering in the title block as also in the drawings is done by using the Leroy Lettering sets. The Leroy template numbers are furnished in figure 6.

7.1. *Numbering of drawings*:—Each drawing prepared in the Central Designs Office bears, an appropriate drawing number which consists of a letter and two numbers one on either side separated by a dash.

7.2. Each project is assigned a number such as 110, 210, 310 etc. and a distinguishing letter which is the first letter of the name of the project or dam. The several drawings in the project are given such numbers separated from the project letter by a dash. The month and the year are also indicated at the bottom of the title block in the middle panel. For example, in the notation 710-K-10,

710, indicates the number assigned to the Project,

K, indicates the first letter of the name of the Project and

10 indicates the number of the drawing in the series relating to the Project 710.

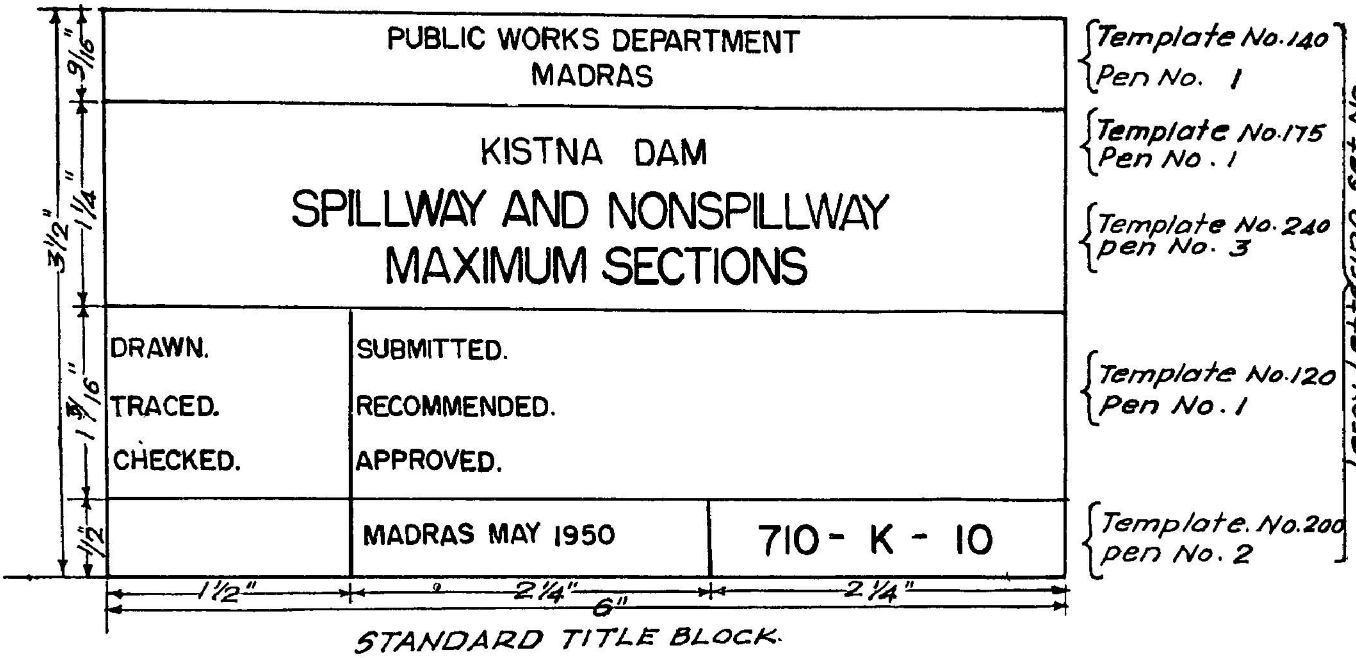


Figure 6.

8. *Drafting symbols and notations*:—Standard symbols and drafting notations are illustrated in figure 7.

9. *Tracings* :—Every tracing will bear the initials of the designer, tracers and checkers directly concerned in its preparation.

10. *Revisions* :—A drawing that is prepared to supersede or replace a previous drawing should be marked "supersedes drawing No............" inserting the proper number. This notation is indicated at the left side panel at bottom of the title block. The new tracing should be assigned a new drawing number. The old tracing should be marked "Superseded by drawing No........." with the proper number.

11.1. *Reproducing drawings* :—Reproducing drawings to the same scale as the original drawings may be made by means of cloth or paper tracings of the originals from which blue prints or contact prints are taken.

11.1.1. Blue prints (white lines on a blue background) are prepared directly from cloth or paper tracings or from other transparent paper. The blue print is inexpensive, not easily soiled, does not deteriorate rapidly and may be quickly produced. However, in this type of print there is a liability for unequal shrinkage, due to the wetting and drying process resulting in the exact scale of the original not being reproduced in the print which will be necessary for precision work.

11.1.2. Dyalyn prints (coloured lines on a white background) are usually used when a print to accurate scale is required, as the prints are exactly to the scale of the original tracing. The white background permits the marking of notations on this and colouring work will be easier in this type.

11.2.1. The usual method of taking blue prints involves lot of manual labour, and calls for fair and sunny weather for exposure. A photo copying machine, which is of a mechanical and all weather type is in use, in the Designs Office. This is used along with a developing machine. These are described below :—

The Photo copying machine was supplied by Messrs. J. Halden and Company Limited, of Manchester. It is a "Double pattern continuous electric photo copying machine—Type 242" and is fitted with high power mercury vapour gas discharge lamps. Infinitely variable speed control gear complete with electric equipment is also provided.

11.2.2. The whole mechanism comprises of the following :—Nine numbers of high power mercury vapour gas discharge lamps of capacity 400 Watts each are fitted vertically downwards in the centre of the machine in one single row.

These lamps are distributed into three circuits of three numbers in each circuit with individual switch control. A fan is attached in one of the lamp circuits for cooling arrangements.

11.2.3. This row of lamps is enclosed by two hemispherical glasses of $\frac{1}{8}''$ thick and 4 feet in length forming a glass cylindrical tube of 18" diameter and 4 feet long. A revolving mechanism is also provided with guide rollers and bulbs with variable speed control and gear complete. The speed of rotation can be varied from 5 to 20 feet per minute. It is also provided with feed board on either side of the machine, which facilitates for taking two prints simultaneously at a time. Two numbers of $\frac{1}{4}$ H. P., A. C. 230 Volts motors drive the mechanism individually on both sides and with individual control switches.

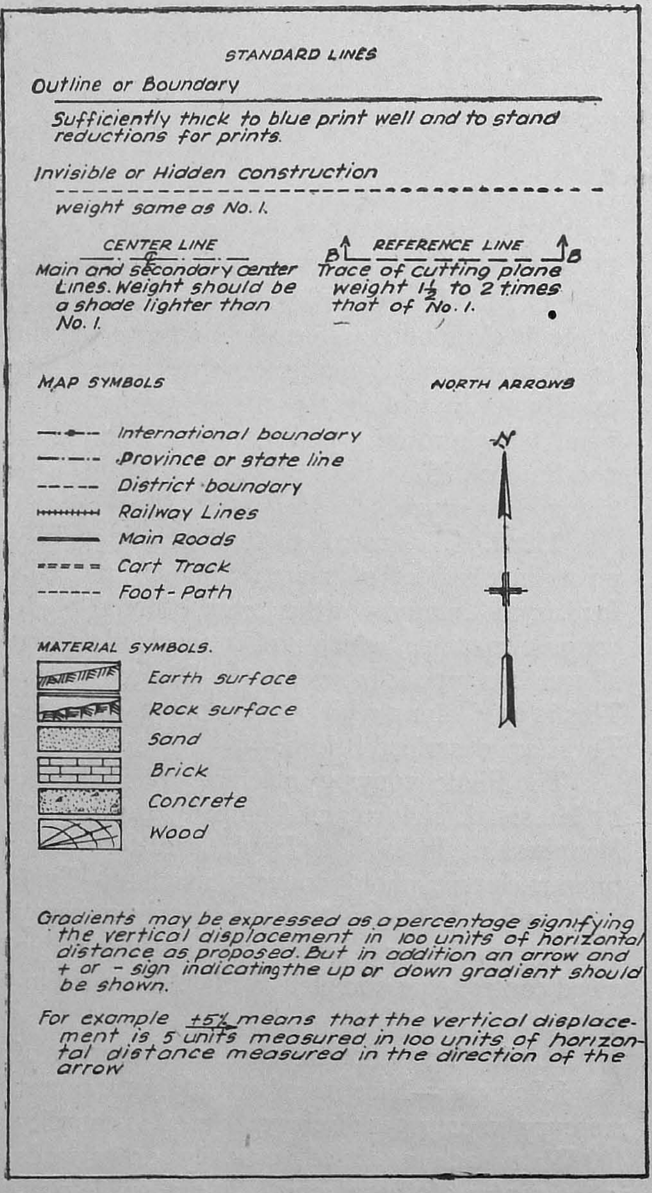


Figure 7.

11.2.4. The following procedure is adopted in taking prints :—The tracings together with the blank sheets, are fed into the machine. The tracings automatically come into contact with the convex side of the glass cylinder and get exposed to light and comes out into the delivery chamber. Photographs of the machine are shown in figures 8 and 9.

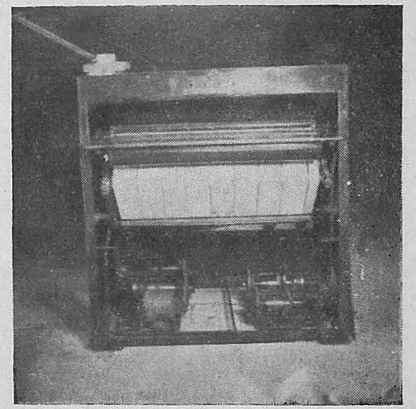


Figure 8—Halden's Copying Machine

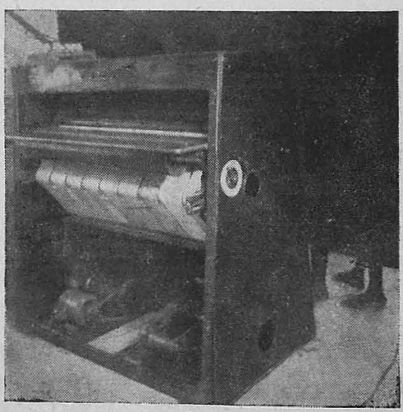


Figure 9—Halden's Copying Machine (Another View)

11.3. The copies of tracings after exposure have to be developed and this is done by a developing machine (Fig. 10) which is also power driven.

11.4. The process of taking prints is described below. The prints are fed into the machine face downwards where pre-damping solution is automatically spread over its entire surface. This is followed by a combined developing and

fixing solution to complete the process. The print is then delivered ready for use as soon as the slight surface damp has dried. With this machine, drawings with blue or brown lines on white background can be got out.

11.5. *Advantages* :—Prints can be produced under any weather condition upto a maximum width of 42″. It is rapid and gives increased output. There is economy in time and reduction in labour costs. It requires no developing baths, drying machines, ovens or racks. The space occupied is the least.

Figure 10—Developing Machine

11.6. The cost of the equipment comprising the printing and developing machines is £ 362–10–0 for a complete set.

12. *Folding of prints* :—The standard size drawing of 40″×22″ is never folded and attached to correspondence files. They are stored without folding in the filing cabinets. Folding is resorted to when they are to be transmitted from place to place by post. The method of folding in such cases is illustrated in figure 11.

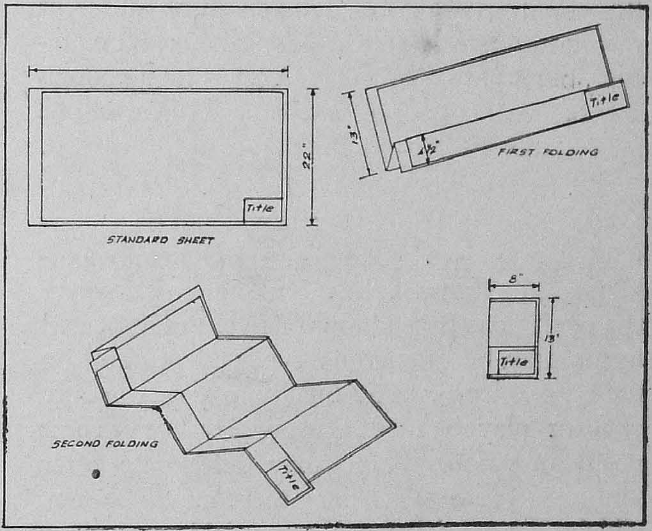


Figure 11.

Formwork for Concrete Dams

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1. *Introduction* :—The subject of forms for concrete dams deserves a detailed study in every case as a reasonable percentage of the final cost of concrete is taken up by formwork. In the U. S. A. it is found out that for low dams, the cost of formwork amounts to about 30 to 40 per cent of the cost of concrete, whereas for high dams it may be about 15 to 20 per cent. In this country the figures are likely to be different owing to the different rates for labour and materials, but still the percentage cost is high enough and the final cost of concrete structures will be appreciably affected by the nature of forms used.

2. *Factors Influencing Design*:—For repetition work, "In Place" forms will not be as economical as prefabricated forms. Generally, prefabricated forms will be more economical where the repetitions exceed four or five. Prefabricated forms may be of various types, depending on the type of work. The quality may vary greatly as forms may be made of wood, steel or of composite materials. Some may deteriorate after four or five uses, whereas there may be others which may not deteriorate appreciably, even after several repetitions. Large outlay on the manufacture of forms which are more or less permanent will not generally be justifiable as the number of repeated uses may not be commensurate with the cost of fabrication as the superficial area to be covered by each type of form in any particular work is quite nominal.

3.1. *Choice of a Type* :—For our conditions, forms of the composite type may be more suitable. However, the percentage of outlay on forms is based on so many incidentals that a detailed study would be necessary before arriving at a suitable type.

3.2. The following are some of the factors which have to be considered—the coverage for each type of form, form handling facilities, capacity of the concrete placing equipment, the programme of execution, height of lift, cost of labour and materials. Some of these factors will guide us in deciding on the type and quality of forms to be used, whereas other factors will help us in estimating the number of forms required for each type of coverage like, for example the upstream, or downstream facing, shape of overflow crest and the like.

3.3. The forms should also be sound, practical, and easy to fabricate, handle and strip and at the same time economical in outlay. The forms should be durable and should be capable of being reused to the maximum extent possible. The size of the members should be selected in such a way that deflections are limited to less than an eighth of an inch. For general design purposes for lifts not exceeding five feet the pressure against forms may correspond directly to the liquid pressure at the unit weight of wet concrete. The pressure will naturally depend on the rate of placement, cement content and slump, but the liquid pressure recommended above will generally be suitable for design purposes.

3.4.1. The number of forms should be such as to fit in continuously with the rate of concrete placement.

3.4.2. As a rule, if a dam is programmed for completion in a fixed time, the daily average rate of concrete placement may be worked out after considering the local seasonal conditions and the practical limitations on labour, materials etc. The equipment for concrete mixing, handling and placing will then be decided on, assuming that the plant will be working with an over-all efficiency of about seventy per cent. For this seventy per cent placement of concrete, the number of forms should be such that the concreting plant is not unnecessarily idle for want of completion of formwork and at the same time excessive number of forms are not idle at any time, the rate of concreting being slower. The rate of formwork should be such that a block gets its next lift in three to four days' time. With this time factor in view, the number of forms will have to be decided upon and the concreting programme drawn up in such a way that there is co-ordination between the rate of formwork and rate of concreting.

3.5. The architectural and structural features of the dam should also be such that easy formwork is possible and hence non-uniform features have to be avoided in the interest of

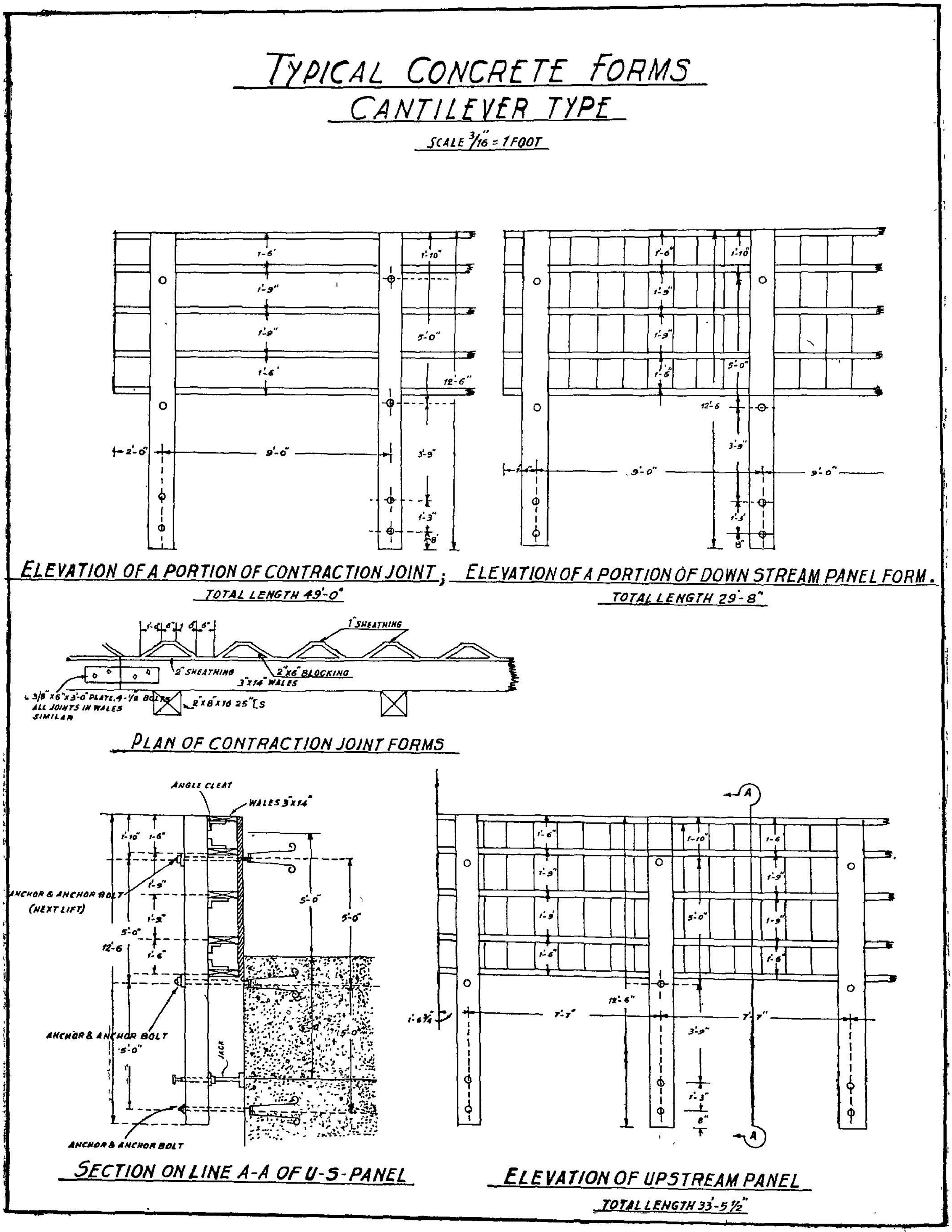

TYPICAL CONCRETE FORMS
CANTILEVER TYPE
SCALE 3/16" = 1 FOOT
ELEVATION OF A PORTION OF CONTRACTION JOINT;
TOTAL LENGTH 49'-0"
ELEVATION OF A PORTION OF DOWN STREAM PANEL FORM.
TOTAL LENGTH 29'-8"
1" SHEATHING
2" SHEATHING
2"x6" BLOCKING
3"x14" WALES
2"x8"x16 25"[S
PLAN OF CONTRACTION JOINT FORMS
ANGLE CLEAT
WALES 3"x14"
ANCHOR & ANCHOR BOLT (NEXT LIFT)
ANCHOR & ANCHOR BOLT
JACK
SECTION ON LINE A-A OF U-S-PANEL
ELEVATION OF UPSTREAM PANEL
TOTAL LENGTH 33'-5 1/2"

Figure 3.

anchor bolts, which are removed when the panel is ready to be raised. Anchorage at the top of the form is obtained by means of 1¼" diameter pipes with flattened ends. As a lift of concrete is nearing completion these anchor pipes are embedded in the wet concrete and their upper ends are temporarily connected to template arms, which hold these anchors in proper relationship to the form when the concrete sets. When the form is lifted, with a little minor adjustment, the form can be bolted to this anchor. A rod in place of the pipe is not suitable for anchoring as the required degree of rigidity in the tie will not be obtained and the tie is liable to buckle when wet concrete is dumped near the tie. Pipe anchors which serve as ties are therefore used. They also ensure rigidity of the formwork by keeping it in true alignment. For anchoring the lower edge of the panel, " J " bolts are used. These have also to be embedded in the concrete as the lift progresses and a dummy bolt in the form keeps it at the proper place when the concrete sets. This type of form was used on the Hiwassee Dam in U. S. A.

6. *Cantilever Type of Form*:—This type of form is illustrated in figures 2 and 3.

6.1. Fig. 2 is a design for a steel form adopted by the Irvington Form Corporation, U.S.A. The general principle of the form can be seen from the figure. This has a single row of anchors in the lift immediately below the lift that is being concreted.

6.2. Fig. 3 is a typical wooden form with double row of anchors, one row being in the lift immediately below the lift which is to be concreted and the other row in the next lower lift. This type of form was used at the Davis Dam U.S.A., for the spillway and Power Plant structures.

6.3. The quantity of embedded parts in the cantilever type will be less than in the panel type. For lifts exceeding five feet, the panel type is more suitable than the cantilever type.

7. *Accessories in use of Forms*:—

7.1. For handling forms, it will not be economical to use the heavy lifting equipment which is used for concreting. Lighter portable type of equipment is therefore necessary. Mostly " A " frames with manual hoists or AIR hoists are used. Fig. 2 illustrates how the forms are lifted to the next higher position by means of simple devices. Sometimes small mobile cranes are used, the crane being shifted from block to block by means of the main concreting cable-way or gantry crane or hammer head crane, or derrick, whichever is utilised for the particular job for concrete placement. For our conditions, simple " A " frames having wire rope back stays with turn-buckles and simple light type of mechanical winches for lifting, seem to be quite suitable.

7.2. *Anchors and Anchor Bolts*:—Several types of anchors and anchor bolts are used, but the " J " type of bolt as anchor and the female bolt as anchor bolt are most popular. In this method it will not be necessary to cut away any projections from the concrete face and the hole left by the anchor bolt can be easily grouted. This type of anchor bolt is illustrated n figure 4.

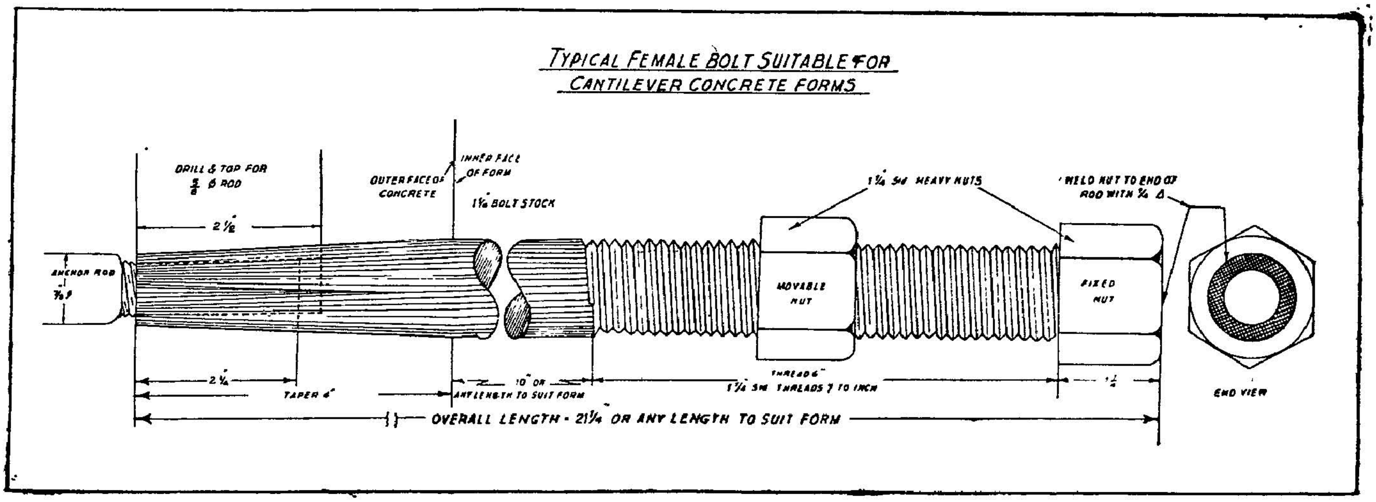


Figure 4.

7.3. *Scaffolding*:—For erecting and stripping of forms, a cheap and light type of scaffold is necessary on the form itself. Incidentally this scaffold will also prevent the dropping and consequent loss of tools, anchor bolts, etc., which will cause delay in formwork.

8. *Alternative type discussed*:—

8.1. For concreting of dams it will not be generally conventional to use precast concrete forms. Of late, however, these have been tried and have shown good results.

8.2. An example of precast concrete formwork is given in the Engineering News Record of May 19, 1951, (Pages 28 to 33). Precast blocks of concrete have been used on the face of the L'Aisle Dam in France, which not only give a novel facing, but also serve as concrete forms. The blocks are five feet by seven feet and are 18″ thick and weigh 3½ tons each with two projections of two feet inside the dam which serve as anchorages. These precast units were used for five feet lifts and found to be quite satisfactory. It would be worthwhile trying such forms in India with suitable modification in size and shape, as large savings are bound to result from it. Materials required for formwork are costly in India and any type of formwork which can be made to form an integral part of the dam as the precast concrete form described above should be explored to the fullest extent. When such precast units are used, it may not be necessary to keep rigidity to the five feet stage. The height of each lift may be somewhat curtailed to afford ease in handling. This reduction in the height of each lift will not in any way hamper progress as in other types of formwork, where the maximum out-turn has to be obtained with the minimum of forms and minimum number of settings or forms, both of which are costly. However, this will be a matter for the constructional engineer to decide with reference to the overall merits of the case. In the case of precast concrete units, the blocks can be manufactured far in advance and in very large numbers and yet unlike other forms there will not be any waste in capital. The formwork can be used on every available working face unlike other forms (where investment on the number of forms has to be limited and the forms should be re-used as many times as possible for reduction in overall cost of concrete.)

8.3. The advantages of concrete forms are numerous and the writer feels that large savings in the construction of concrete dams can be effected if this type of formwork is adopted. The type of labour available in India is also adaptable to this work. Also a neat finish can be assured; the progress of work will be faster than with the conventional forms and any intricate curve or architectural detail can be executed without much difficulty. In fact, at present, the dams built in South India have a facing of coursed rubble stone and the hearting is of random rubble. A minor departure from this type of work in having a facing of concrete blocks with suitably designed inside projections for anchoring and a hearting of concrete would be a step in the right direction, which would make the work independent of skilled masons, increase the speed of construction and will ensure savings in labour as well as materials.

Developing the Water Resources in the Madras State.

1. The water resources of the Madras State, after the separation of the Andhra State have been greatly reduced. Most of the rivers in South India have been harnessed either in a small or big way, ever since the times of the Chera, Chola and Pandyan Kings of old. In many parts of this country, there are tanks for practically every square mile of terrain. Numerous supply channels take off from the nearest rivers to feed them and most of what is left in the sandy river beds is tapped by means of spring channels. Thus all normal flows have been already used up.

2. Now what remains unused are the heavy floods which last only for a few days, at a time. While all the normal flows and a part of the floods may have been used up by existing channels another sizable part still escapes into the sea. This part can be conserved and used by large storage reservoirs across the river; and if these floods occur less frequently than once a year, the reservoirs have to be made big enough to hold the floods when they occur and "Carry over" stored waters from one good year to another when there may be no surplus waters to be stored. Only then can supply be made dependable and irrigation of new areas be attempted. It is true that some water will be lost by evaporation but these losses would be relatively small in lakes more than thirty feet deep. With smaller reservoirs which would fill in some years and would remain empty in others, only second crop on lands already irrigated can be grown.

3. The popular impression that such reservoirs will hold up the supply in rivers now used for irrigation lower down, is wrong. They can be so operated as to hold up only waters that will otherwise escape into the sea. Far from causing any harm to the people below, it can actually help them at the most critical times either directly by releases of stored waters from these reservoirs or indirectly by feeding the springs in the river. This is because the underground waters in the river below the "Storage," are augmented by the head of water stored up in the reservoir. Experience has shown that during typical drought periods lasting for months on end when the natural flows in the river were hardly adequate to sustain even a small percentage of the standing crops on the old irrigated areas and the loss of a major portion of these crops was inevitable, the issues from the stored waters of a large existing reservoir, upstream, have saved the entire crop. In other areas where there was no such reservoir the lands were either left uncultivated or the crops raised were lost. A study of the Mettur and Papanasam Reservoirs in their operations relative to irrigated areas downstream will reveal the significance of these observations.

4. Big reservoirs involve large and costly works and their benefits extend either to areas already irrigated or to bring in vast areas under cultivation. To cover other areas which do not have facilities for such development, there are other ways of using the natural flows in rivers which may be here described.

5.1. One such method is an extention of the present method by means of building an anicut across the river and taking off a supply channel above it, both for irrigating directly new lands and for feeding tanks which do not get adequate supplies from their existing catchments.

5.2. Let me here elaborate this method, further. The one obstacle in the past to the construction of new anicuts and digging new channels from it, has been the objections put forward by lower down ryots, that these anicuts will divert supply which would normally reach them in the absence of these new anicuts. It would, therefore, be necessary to ensure that every new anicut would not interfere with the existing irrigation. Where this can be ensured there can be no objection to build new anicuts, according to existing practice, but where this cannot be done and we still want to make use of the heavy and occasional floods which get

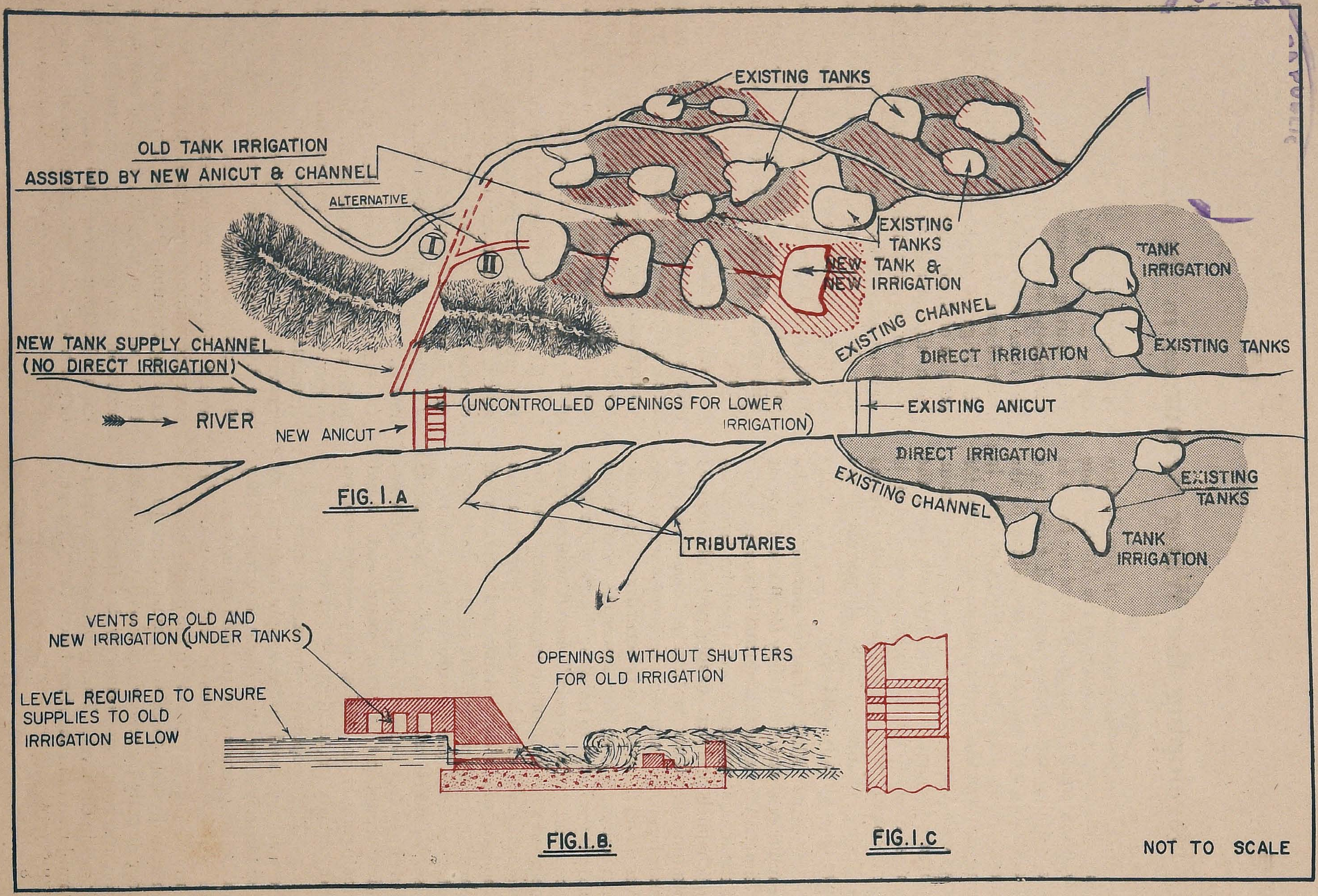

EXISTING TANKS
OLD TANK IRRIGATION
ASSISTED BY NEW ANICUT & CHANNEL
ALTERNATIVE
I
II
EXISTING
TANKS
NEW TANK &
NEW IRRIGATION
TANK
IRRIGATION
EXISTING CHANNEL
NEW TANK SUPPLY CHANNEL
(NO DIRECT IRRIGATION)
DIRECT IRRIGATION
EXISTING TANKS
(UNCONTROLLED OPENINGS FOR LOWER
IRRIGATION)
EXISTING ANICUT
RIVER
NEW ANICUT
DIRECT IRRIGATION
EXISTING CHANNEL
EXISTING
TANKS
FIG. I. A
TRIBUTARIES
TANK
IRRIGATION
VENTS FOR OLD AND
NEW IRRIGATION (UNDER TANKS)
OPENINGS WITHOUT SHUTTERS
FOR OLD IRRIGATION
LEVEL REQUIRED TO ENSURE
SUPPLIES TO OLD
IRRIGATION BELOW
FIG. I. B.
FIG. I. C
NOT TO SCALE

Figure 1.

wasted into the sea, we must adopt other methods.

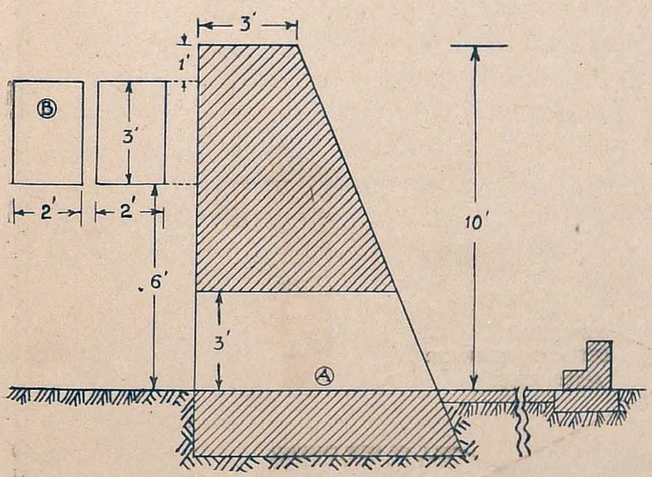
5.3. The conditions governing the construction of a new anicut of this description are, therefore,

(*a*) Supply contributed by the river above the new anicut to old irrigation and supply channels and tanks below this anicut, should not be interfered with.

(*b*) No new direct irrigation should be attempted under the new anicut as the very proposition is to use only heavy and occasional floods which would otherwise escape into the sea; and

(*c*) The cost of the work should be low and the benefits wide-spread.

5.3.1. In regard to (a), a new anicut can be built with openings without shutters so that they can discharge at all times and without interruption of any kind. At a particular level above the level of these openings, the legitimate contribution from the upper catchment of the river to all the lower irrigation should be fully satisfied. Let this be, say, three feet above the openings and let the openings themselves be three feet high (vide sketch below).



A—Low level openings of Central Shutters for existing irrigation.

B—High level off-take for new irrigation.

Then there should be no objection to divert floods reaching a level of above six feet. Now a new head sluice may be provided in masonry with its openings at a level six feet above the level of openings in the anicut and a channel excavated in rear of it. Let the height of the vents of this sluice be three feet. Then the top of its opening is nine feet above river bed. If the anicut is built to a height of, say, ten feet, the new channel will draw all the flood flows between the levels six feet to ten teet above the anicut openings. When the floods begin to overflow this new anicut, ten feet high, there will be more than what will be required to feed the new channel.

5.3.2. Dealing with condition (b), in para 5.3, above, the important point about this new channel is, that ***no attempt should be made to irrigate directly any land under it.*** This is because the floods are occasional and cannot provide a continuous flow necessary for direct irrigation. The channel should be used to fill up, either old tanks or new tanks should be formed in suitable locations and water diverted should be used to fill them up. To fill old tanks, a good method is to lead the water through the new channels and drop them, into an adjacent small valley which already feeds a chain of tanks, if conditions favourable for it exist there.

5.3.3. Regarding (*c*), the third condition in the proposals, the channel should be made as short as possible to keep down the cost, but it should be as wide as possible so that it can abstract large supplies within the short period that the floods are likely to last. This will enable tanks to be filled up and enable comparatively, large areas to be newly brought under irrigation either under the existing tanks or tanks that can be newly formed. The cost per acre benefitted will be correspondingly reduced. Fig. 1 illustrates this proposal.

6.1. In the above proposal, the reference is mainly to masonry or rough stone anicuts across comparatively large rivers. A variation of this will be possible in the case of small sized streams and rivers. An earth dam can be built across these rivers with large R.C.C. pipes or masonry tunnel under it, to pass the contribution due to old irrigation below from the upper catchment and the new sluice and channel can be so located that it will draw water only above the level at which all lower irrigation demands are fully satisfied. In such cases there should be an overflow at one or both ends of this earth dam located on suitable ground and its length must be such

that very high floods will be fully disposed off with about 18″ of water running over the ground which should be lightly paved or covered with turf sods to function as a natural ground escape. This variation will help certain class of works. Figure 2 illustrates this proposal.

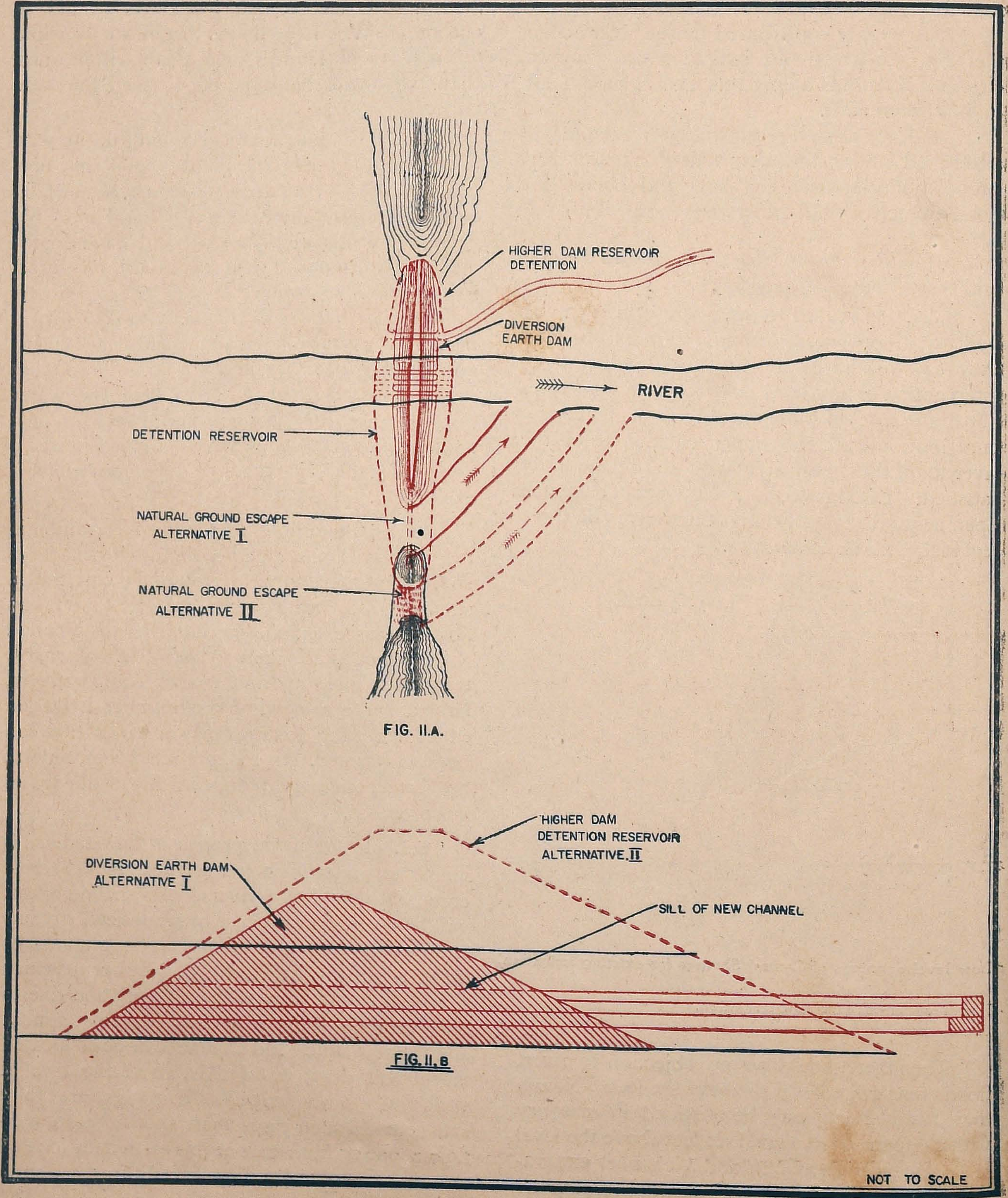


Figure 2

6.2. It may here be mentioned that both masonry or earth dam types can be expanded in scope by making them higher so as to serve as "Detention Reservoirs". These types of reservoirs prolong the duration of flood flow in the rivers and help to flatten out flood peaks and enable the channels to draw off supplies for much longer periods than would be possible otherwise. Their use for soil conservation purposes is well-known and practised in the United States of America. The "Panjapatti Reservoir" in the Tiruchirapalli District is an example of a normal Reservoir converted into a Flood Detention reservoir purely for purposes of reducing floods and the damage they cause to the lands below.

6.2.1. Doubts may be entertained as to the practical value of schemes of this nature and as to whether (i) water does really escape to the sea in bad years, (ii) the scheme will really be able to help tanks to fill up, (iii) the anicuts or dams will in practice, not affect the old irrigation below them ; and (iv) it will be economical in cost.

6.2.2. Regarding (i), the writer had an occasion to examine the records of flow of one of the driest of rivers in one of its worst seasons. It was found that during a few days of heavy north east monsoon rains, which generally failed over the whole area in that year, water did actually flow into the sea for about three days and the existing anicuts and channels were unable to use this water. A portion of these flows could have been used, had there been other new anicuts and new channels designed and built, as described here.

6.2.3. Regarding (ii), it was found that the tanks were all nearly empty in the period referred to in 6.2.2. above. If new channels of adequate size had existed, a considerable measure of assistance could have been afforded to the tanks. As an example of a tank filling channel from a river of this type may be mentioned the Kaveripauk tank supply channel from the Palar which helps to draw and send down large supplies to this tank in a few days time. This would show, that if there are flows in the river lasting even for a few days and the channels are fairly large, the tanks can be helped very substantially by the scheme. An illustration of a typical supply channel of ample proportions to abstract flash floods to feed a tank is shown in Fig. 3.

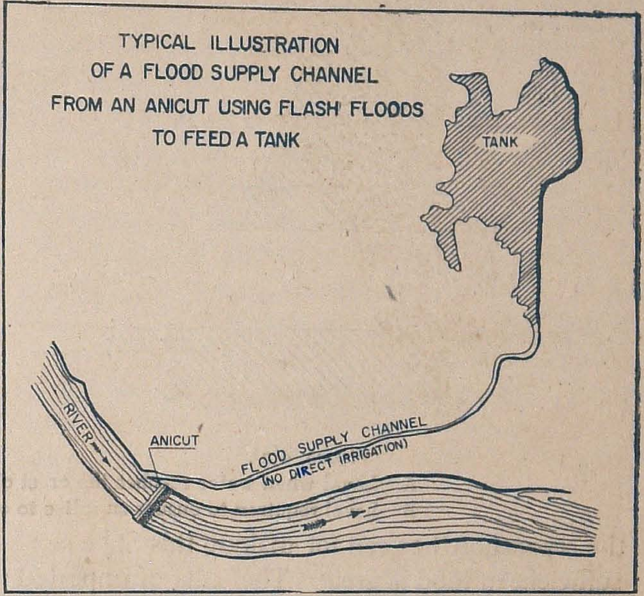


Figure 3.

This Anicut will have uncontrolled openings and the sill of the supply channel vents will be higher than the anicut openings. (Vide para 5.3.1)

6.2.4. Regarding (iii), the vents in the anicut or dam are intended to ensure supplies legitimately due to lower irrigation. They are purposely designed without shutters and regulating arrangements ; their size should be not less than 10 ft. long and 3 ft. high so that no interference with them is possible. If any interference is observed, in the actual working of the anicut, separate Government establishment can be provided to keep a watch over the work. If interference still occurs or is apprehended, the vents may be joined up into one or more openings with height upto crest level of anicut as shown in Figures 4 (a) and (b). (Page 34.)

If this is done and the length of the openings made greater than 10 to 15 feet, interference would not, generally, be possible. Some water might get wasted with this arrangement but a good deal will still be available for the new tank feeder channel.

6.2.5. It will be difficult to generalise on (iv), the cost aspect. The cost of each scheme should be investigated and it is only schemes which would be beneficial that need be taken up. In the context of the loss of water resources after

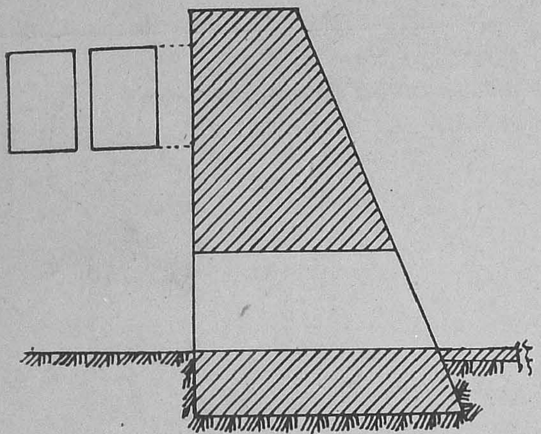


Figure 4(a).

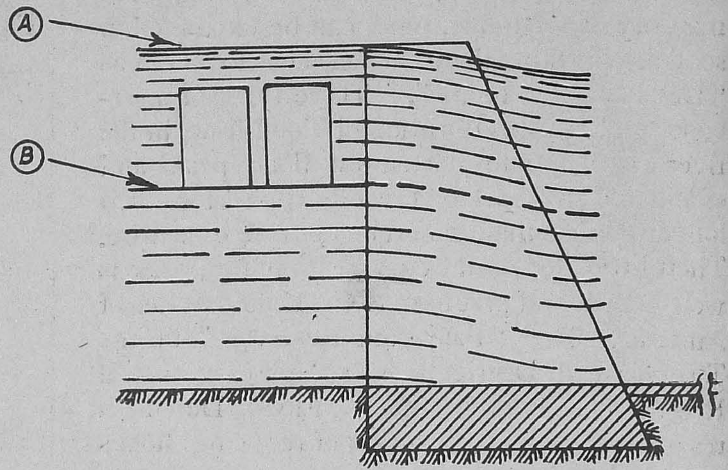


Figure 4(b).

A—Level when water reaches the crest of the anicut.
B—Level required to ensure supplies to old irrigation below.

the separation the need for making this State self-sufficient in food is great. The cost of imported foodgrains is so high that any practical scheme of water utilisation might still show an overall saving in the food economy of the State.

7. The object of this note is to describe in popular language both for the Engineers and the Public, one of the several ways, the water resources of the present State of Madras can still be put to constructive use, without injury to regular users. As all such schemes can only be carried out, if people understand and co-operate in such measures, it is necessary that such support andco-operation should invariably be secured.

(A. R. VENKATACHARI)
SPECIAL CHIEF ENGINEER.

Madras State

Kurnool-Cuddapah Canal Project

The Kurnool-Cuddapah Canal Community Project comprises 223 villages covering an area of 1,022 sq. miles with a population of about nine lakhs.

Agriculture:—More than 18.5 tons of improved paddy seeds and 985 lbs. of green manure seeds have been distributed. Thirteen tons of chemical fertilizers and 760 glyricidia seedlings and cuttings have been distributed. Contour bunds have been constructed on 370 acres of land and 22 plots have been laid out to demonstrate the Japanese method of rice cultivation.

Animal Husbandry:—The castration of scrub bulls, treatment of non-contagious diseases and inoculations are the main features of the programme under this head. So far, 1,191 cases have been treated for various diseases, 308 cattle castrated and 420 vaccinated. The breeding of improved poultry has also been started.

Communications:—Apart from the main Cuddapah-Nandyal-Kurnool road, there are hardly any other roads in this project. Approach roads as well as inter-village roads are now being built by the villagers themselves. Fourteen pucca roads are under construction.

Health and Sanitation:—Steps are being taken to supply good drinking water by digging new wells and reconstructing or improving the existing ones. One primary health centre has been opened at Yallur. A building for this centre is to be constructed at a cost of about Rs. 40,000. Of this amount, the Government's contribution will be Rs. 10,000 and the balance will be contributed by the people in cash, labour or material. On an average, 200 patients are being treated daily at this centre.

Co-operation:—There is a sufficient number of multipurpose co-operative societies in this project, but the whole movement is in a moribund condition. The project executive officer is now taking steps to rehabilitate the movement.

The people's participation and co-operation in the area has been very encouraging. In the village of Tallampuram, 30 students from the Proddattur Government Girls' High School organized a sanitation drive. College students are also taking part in the work of building roads, constructing houses and organizing sanitation drives.

Lower Bhavani Project

The Lower Bhavani community project consists of 187 villages — 184 in the district of Coimbatore and three in the Karur Taluk of Tiruchirapalli district. The project covers an area of 701 sq. miles with a population of 5.6 lakhs. The main crops are paddy, cholam, cumbu and ragi. The villages selected are mainly those that would benefit from the Lower Bhavani Project Scheme. The area selected is mostly dry except for 22,000 acres which are irrigated by the Tadapalli and Kalingarayan channels.

Agriculture:—The failure of the rains for the past five years has completely upset the agricultural economy of this area. The gram sevaks, however, are doing useful work in propagating improved methods of agriculture.

Over 13 tons of improved varieties of paddy, one ton of millet, 1,824 lbs. of green manure seeds, 5,800 glyricidia seedlings and cuttings and over 250 tons of chemical fertilizers have been distributed. Seven hundred and seventy compost pits and 2,704 manure pits have been prepared. Contour bunds have been constructed on 588 acres of land. Over 160 plots have been laid out to popularize the Japanese method of rice cultivation. Insecticides have been used on 193 acres to control pests. Pisciculture and vegetable gardening are also being encouraged.

One veterinary hospital and five first aid centres have been opened.

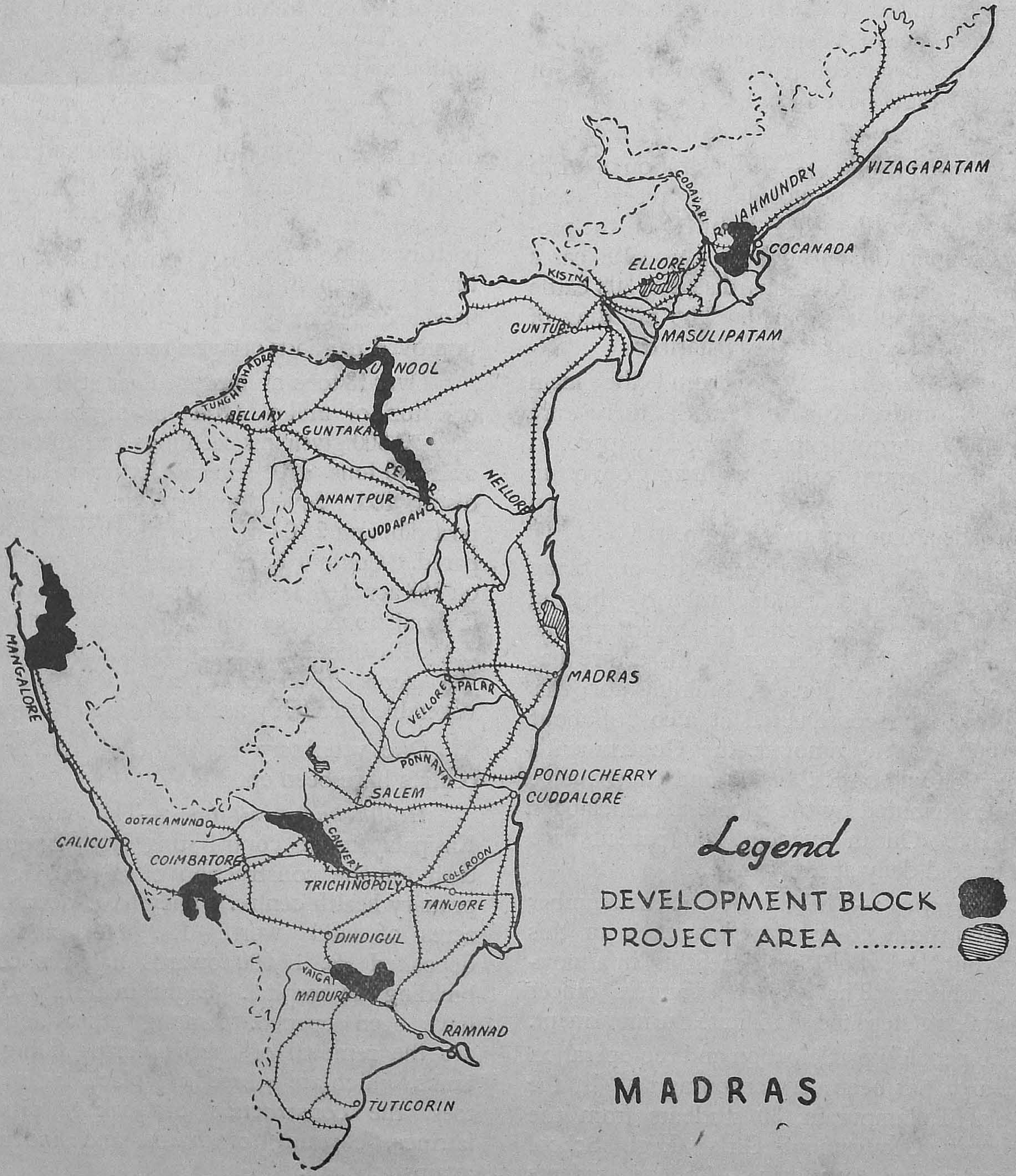
Health and Sanitation:—The villagers of Kasipalayam are contributing land, labour and cash for the construction of a building for a primary health centre. They have donated two acres of land worth Rs. 4,000 and have deposited Rs. 11,000 towards half the cost of building the hospital. Eight maternity centres have been opened. Among other activities, are the removal of rubbish heaps, filling up of tanks, which are a breeding place for mosquitoes, the construction of soakage pits and latrines, cleaning of drains and inoculation against cholera.

Education :—Thirty-one schools have been opened for adults and a community recreation centre organized by the villagers at Kottup-palampalayam. A radio set has been installed in the village of Mukkanamkombai. Cultural programmes, such as bhajans, dramas and folk-dances have been revived in most of the villages. The villagers have constructed 20 miles of approach roads in 35 villages.

East Godavari Project

The community project in the East Godavari district comprises 242 villages in the four taluks of Ramachandrapuram, Kakinada, Peddapuram and Pittapuram, covering a total area of 592 sq. miles. The population of the project is about seven lakhs. The main crops produced are paddy, pulses, sugar-cane and ground-nut.

Irrigation :—The development of irrigation in this area aims at utilizing the surplus water



from drains, the lifting of canal water for storage in tanks and the tapping of ground water resources by means of artesian wells and filter point tube-wells.

To harness the perennial flow of drainage water in the river Tulyabhaga which passes through the Ramachandrapuram and Kakinada taluks, the ryots of a group of villages have formed a lift irrigation co-operative society. This society at Rayavaram has been formed with a share capital of Rs. 35,000 and has done good work by installing pumps which are electrically operated and these will impound sufficient water to cover an area of 1,000 acres on which a second crop of paddy will be grown.

The Project Administration granted a loan of Rs. 1 lakh to the State Electricity Department for the supply of power to the pumping sets. The water in the Tulyabhaga river is proposed to be similarly utilized at its lower reaches for irrigation purposes. The Biccavolu-Lingala tank has been renovated and filled with water from the Godavari canal. The water from the canal was diverted to the tank through a channel dug by the villagers and pushed into the tank by electrically driven pumps. Water from the tanks will irrigate a second crop on about 500 acres of land.

Ninety-five filter point tube-wells have been sunk in the area by the villagers. Each well will be able to irrigate about 15 acres of land and costs Rs. 500. Electricity will be supplied to these wells and the cost incurred by the State Electricity Department will be paid from the project funds as loan.

Agriculture :—Steps have been taken to make every village self-sufficient in the supply of improved quality of seeds and organic manures. Short-term agricultural loans have been sanctioned to the ryots for the purchase of chemical fertilizers. The Japanese method of rice cultivation is being demonstrated on 32 plots.

One veterinary dispensary at Rayavaram and three veterinary aid centres at Kapileswarapuram, Mandapeta and Anaparthi have been opened. The people have contributed buildings free of rent and medicines worth about Rs. 1,300 for these centres. Over 2,410 heads of cattle have been treated, 576 bulls castrated and 1,652 cattle vaccinated.

Health and Sanitation :—Three primary health centres and twelve maternity centres have been opened in this project. All these centres are located in buildings given by the villagers, either free of rent or as gift. At the health centres, over a lakh of people have already been treated.

Malampuzha Project

The Malampuzha project comprises 113 villages in the Palghat taluk covering an area of over 640 sq. miles with a population of nearly six lakhs. The irrigated area, either perennial or non-perennial, is negligible and is less than 2,000 acres.

Agriculture :—Two hundred and twenty-four compost pits have been dug and about eight tons of chemical fertilizers sold; over 1,200 glyricidia seedlings have been distributed and 42 glyricidia nurseries raised. On 2,000 acres of land, sesbania seeds have been sown and 77 sesbania nurseries raised.

Three veterinary first aid centres have been opened.

Health and Sanitation :—At the primary health centre at Coyalamanam new blocks have been constructed at a cost of Rs. 20,000. The Government contributed Rs. 10,000 and the balance was contributed by the public in the shape of land, labour and cash. Six maternity centres have been opened to serve the needs of about 28 villages. For these centres the people have provided buildings free of rent and have met the cost of the maternity kit.

Communications :—In the first block, 20 miles of kuchcha roads have been constructed. On one of these roads in the village of Koduvayur, a bridge is being constructed at an estimated cost of Rs. 10,000. Three culverts have been constructed on the Mannam–Periyapalem road.

South Kanara Project

The South Kanara community project comprises 302 villages and extends from the Arabian Sea to the Western Ghats, covering an area of 1,250 square miles with a population of over six lakhs. One-third of the project is Malnad and is covered by jungle without proper means of communication.

Agriculture :—About 2,000 mds. of improved varieties of paddy seeds have been put at the

disposal of the ryots and indents for over 16,000 mds. have been placed with the Department of Agriculture for the next crop. Improved varieties of crops have been sown on 3,000 acres of land.

Nearly 900 compost pits have been dug and over 33 tons of chemical fertilizers distributed. Over 1,600 demonstrations were arranged to popularise the Japanese method of rice cultivation, the use of improved varieties of agricultural implements and the sowing of green manure seeds.

Three veterinary dispensaries and five first aid centres have been opened. At these centres 889 cases have been treated, 177 bulls castrated and 1,324 cattle inoculated.

Health and Sanitation :—Two primary health centres and 12 maternity centres have been opened at Bajpe and Hebri. The villagers have donated 2.20 acres of land for the construction of a building for the centre at Hebri. The two buildings are estimated to cost Rs. 28,000; half of this amount will be contributed by the Government and the other by the people. At these centres 16,000 cases have been treated. The wells in the area have been disinfected and DDT sprayed to prevent the spread of malaria.

Communications :—This is a major problem in this project because of the difficult terrain. The villagers have, however, contributed liberally for the building of roads and have constructed over 20 miles of approach roads. A number of culverts, bridges, causeways, foot-bridges, etc., are to be constructed on the roads at a cost of about Rs. 1.0 lakhs.

Education :—Additional accommodation is to be provided in five schools at a cost of Rs. 55,000. Of this amount, the people's contrition will be Rs. 45,600.

Nine schools and 17 reading rooms have been started for adults. A community hall is to be constructed at the Bajpe-Mandi centre.

Periyar Project

The Periyar community project, in the Madurai District, comprises 306 villages covering a total area of 494.4 sq. miles with a population of nearly four lakhs.

Because of the failure of the monsoon this year, the Government has sanctioned a loan of Rs. 2.97 lakhs for the deepening of some of the existing wells and the digging of new ones. Four filter point tube-wells have been sunk. The villagers are also repairing tanks, wells, etc

Agriculture :—The project executive officer has issued short-term loans to the agriculturists to the extent of Rs. 1.66 lakhs, for the purchase of seeds and fertilizers. Six hundred and seventy-one compost pits and 2,278 manure pits have been dug. The Japanese method of rice cultivation has been demonstrated on 22 plots.

Animal Husbandry :—One veterinary dispensary at Vadipatti and two centres at Alanganallur and Sholavandan have been started. Over 2,515 cattle have been treated for various diseases, 1,137 bulls castrated and 11,198 cattle inoculated.

Health and Sanitation :—One primary health centre and five maternity centres have been opened. The villagers have contributed two acres of land for the construction of a building for the primary health centre At the health and maternity centres, 22,000 patients have been treated. The people have been vaccinated against small-pox. A number of drains have been dug and soakage pits and latrines constructed. Public and private wells have also been disinfected. Wells for the supply of drinking water are also being dug. The Government has sanctioned about 100 works estimated to cost about Rs. 80,348. The people's contribution to this amount will be Rs. 39,111.

Education :—Additional accommodation is to be provided in five schools at a cost of Rs. 11,012. The people will contribute Rs. 7,490. The project executive officer has undertaken several other small works under this head to be executed by the villagers themselves without any aid from the community project fund.

Communications :—Four metalled approach roads are to be constructed at a cost of Rs. 10,990, half of which will be contributed by the people. In 33 villages either new approach roads have been constructed or old ones repaired.

The people's participation and co-operation in the implementation of the programme in this project has been very satisfactory. The Community Projects Programme has succeeded in bringing concord and harmony among the villagers and factions in the villages have become a thing of the past.

PROGRESS OF WORK FROM OCTOBER 1952 TO JUNE 1953.

		MADRAS (6P)
Agriculture		
1. Compost pits dug	...	3,775
2. Fertilizers distributed (mds)	...	6,214
3. Seeds distributed	...	6,113
4. Implements distributed		48
5. Demonstration farms started	...	...
6. Area brought under fruits (acres)		41
7. Area brought under vegetables (acres)	...	781
Reclamation		
8. Area reclaimed (acres)	...	60
Irrigation		
9. Additional area brought under irrigation (acres)	...	737
Animal Husbandry		
10. Breeding and A. I. centres started	...	2
11. Bulls castrated	...	2,333
12. Pedigree bulls supplied	...	...
13. Pedigree birds supplied	...	...
14. Cattle inoculated and vaccinated	...	22,857
15. Cattle treated	...	10,586
16. Fisheries—Fingerlings supplied	...	4,425
Health and Sanitation		
17. Soakage pits constructed	...	951
18. Rural latrines constructed	...	6
19. Drains constructed (yds)	...	...
20. Wells constructed	...	51
21. Wells renovated	...	26
Education		
22. Schools converted into basic	...	...
23. New schools started	...	1
Social Education		
24. Adult education centres started	...	97
25. Adults under training	...	405
26. Recreation centres started	...	27
27. Community entertainments organized	...	111
Communications		
28. Pucca roads constructed (miles)	...	3
29. Kuchcha roads constructed (miles)	...	91
Arts and Crafts		
30. No. under training	...	...
31. Additional employment (No.)	...	100
Gram Sevaks		
32. No. under training	...	45
33. No. completed training	...	52
Works		
34. Village houses constructed (No.)	...	...
35. Village houses reconditioned (No.)	...	...
People's Contribution		
36. Labour (value Rs. '000)	...	135
37. Cash and other contributions (value Rs. '000)	...	198
38. Total Government expenditure (Rs. '000)	...	1,050

Note :—* Includes chemical fertilizers, town compost and green manure.
P = Full Project.

With acknowledgments to " Kurukshetra " October 2, 1953.

NEWS ROUND-UP

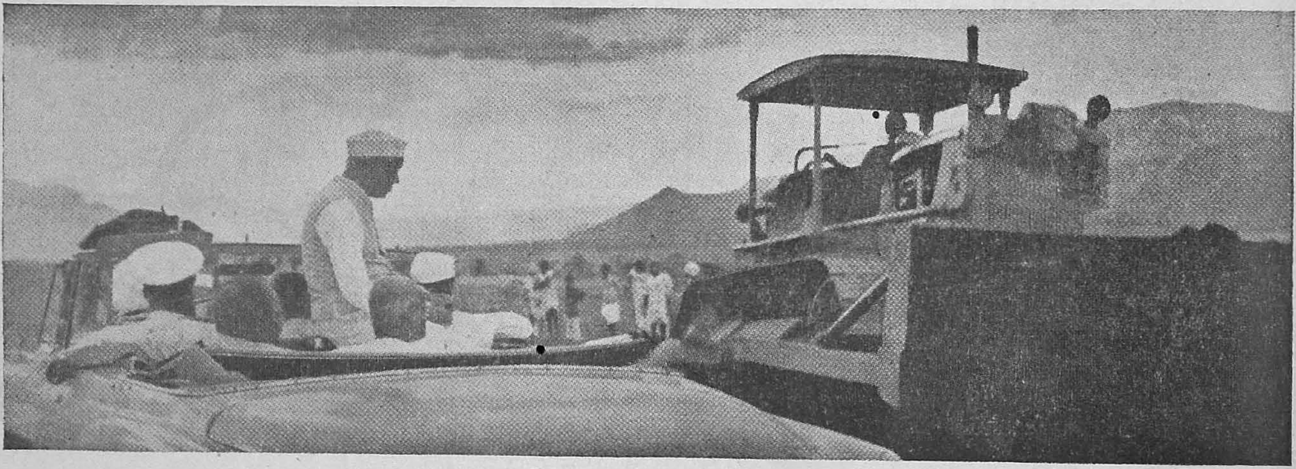
The period under review has been quite remarkable in that it has been associated with the visit of the Prime Minister of India, Sri Jawaharlal Nehru to the two of our Projects *viz.* the Lower Bhavani and the Malampuzha and also the inauguration of the Amaravathi Reservoir Project by the Chief Minister of the Residuary State.

* * * *

The front cover page features a view of the ***Malampuzha Dam*** and an article-cum-art supplement gives salient features of the Malampuzha Project.

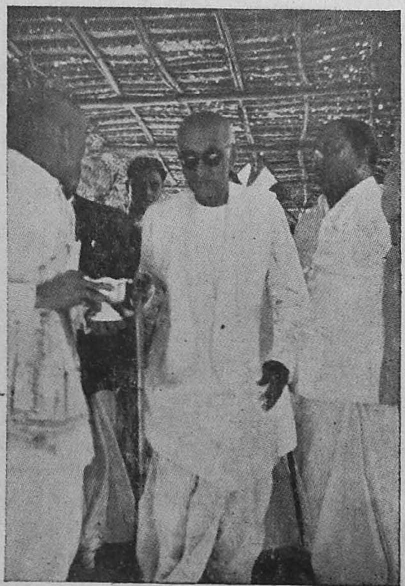
* * * *

A Photograph of the Prime Minister of India and the Chief Minister of the Madras (Residuary) State inspecting the ***Lower Bhavani Project*** on 4—10—'53 is appended below.

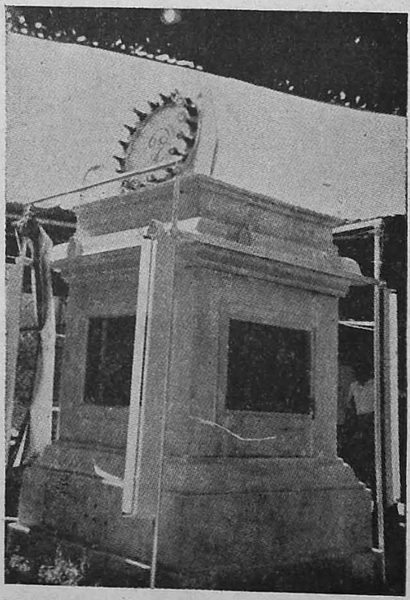


* * * *

The inauguration of the ***Amaravathi Reservoir Project*** was performed by the Chief Minister of the Residuary Madras State on 10—12—1953. Photographs of the Chief Minister being received at the site and the tablet unveiled by him are appended below.



The Chief Minister received with honours



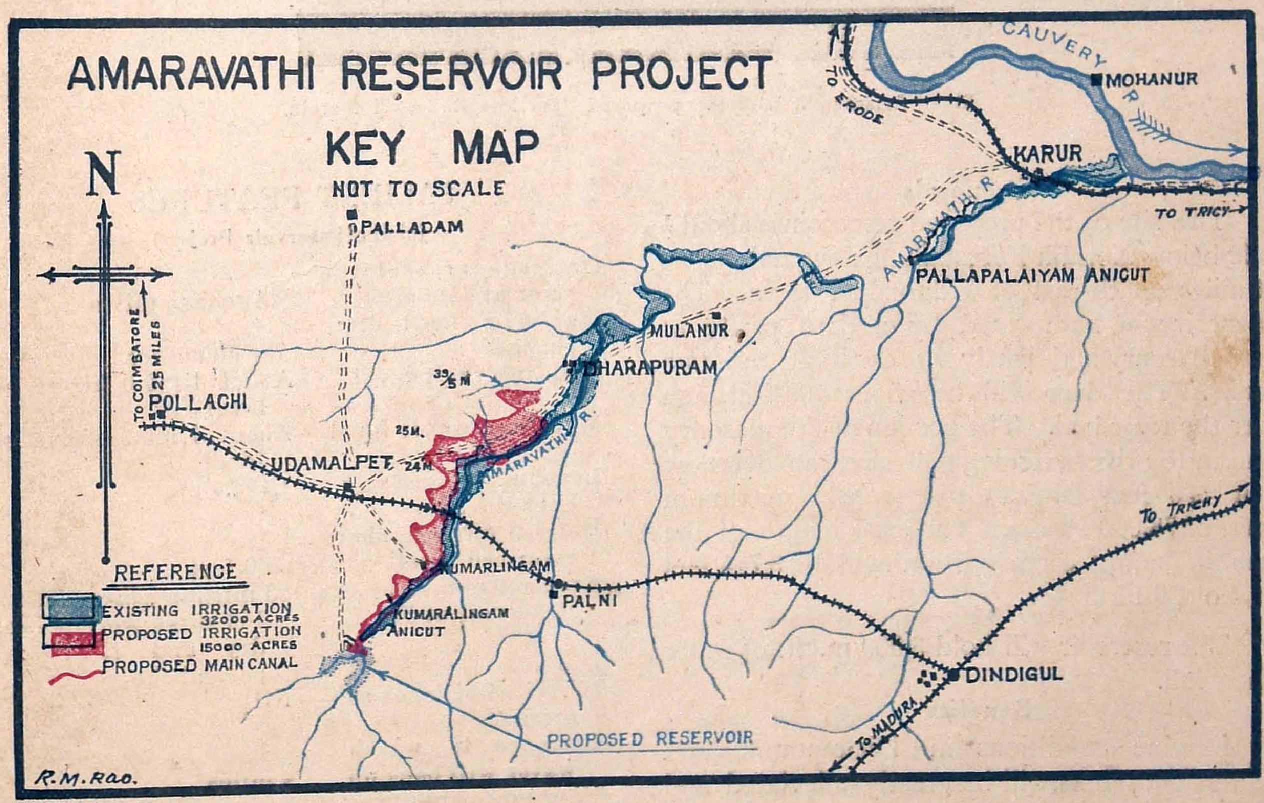
Commemoration tablet unveiled by the Chief Minister

An extract of the salient features of the Project and a topographical map are given below.

Amaravathi Reservoir Project

Coimbatore District—Madras State.

The river Amaravathi rising in the Western Ghats near Munnar in Devikulam taluk of Travancore State at an altitude of 5,000 feet (M.S.L.) is a major tributary of the Cauvery and runs through the Anamalai Hills and dense reserve forests in Coimbatore District before it enters the plains near Kallapuram village in Udumalpet taluk. The drainage area of the river in the upper reaches in the hilly and forest regions is subject to heavy rainfall during the south-west and north-east monsoons. In contrast to this, the Dharapuram and Udumalpet taluks at the foot of the hills are dry areas with small rainfall and are constantly subject to famine. Failure of even this small amount of normal rain is not uncommon and the fact that there was failure of monsoons for three years prior to 1939 resulted in gradual depletion of the resources, unemployment and impoverishment of the landholders culminating in a severe famine in 1939. Government had to start famine relief works and about Rs. 20 lakhs had to be spent. The necessity for an irrigation project to cover some of these dry areas has been felt for quite a considerable time. The present project is a consequence of this. The total area that will be benefited by the Project is about 7,500 acres in Udumalpet and 7,500 acres in Dharapuram taluk. Besides this area the existing irrigation of about 32,000 acres under several channels taking off from the river will also be benefited by the scheme.



River Amaravathi with the proposed dam line indicated therein.

Proposals

The site of the proposed reservoir is about ½ mile below Kombu Forest Bungalow and about 14 miles south-east of Udumalpet town. The reservoir will be formed by a dam partly of solid masonry and partly of earth at the two flanks. The dam will be about 100 feet high over the river bed. The portion of the masonry dam in the river crossing will have an overflow weir 370 feet long to discharge a maximum flood of 78,000 cusecs. The total length of the dam including earth portion will be 3,715 feet or about 6 furlongs.

The reservoir will hold 3,000 m.cft. of water when full.

Benefits

Famine conditions in Dharapuram and Udumalpet taluks will be greatly alleviated and living conditions of the people will be considerably improved. The additional foodgrains expected to be grown under the project will be 5,385 tons of rice and 2,156 tons of millets.

SALIENT FEATURES

(of the Reservoir Project)

Drainage area of the river at dam site	324 square miles
Maximum flood discharge	78,000 cusecs
Full Reservoir level	About 1,165.0 above sea level
Maximum water level	About 1,185.0 above sea level
Level of the roadway over the dam	1,192.0
Height of dam above river bed level.	100 feet
Area submerged by the Reservoir at F.R.L.	83 million square feet or 162 acres wet, one acre dry and 1,734 acres poramboke.
Inhabited villages submerged	Nil
Distance to which water will back up	4 miles
Reservoir capacity	3,000 million cubic feet
Length of canal	40 miles
Area benefited New	15,000 acres
Old (already under irrigation)	32,000 acres
Cost of the Project	272.31 lakhs.

* * * *

This Department is participating in the ***Low Cost Housing Exhibition,*** recently inaugurated at New Delhi.

One of the exhibits is a "Precast Cement Concrete hut" which is well suited for Project areas where temporary accommodation has to be provided for.

Its chief merit lies in the fact that a good portion of the various constituent parts could be salvaged and re-erected in another place.

The most important development during this period, was the inauguration of the New Andhra State on the first day of October 1953. In the Editorial of this issue Sri N. Padmanabha Ayyar, Chief Engineer of the Madras State, has indicated briefly the magnitude of the work that lies ahead of the Irrigation Engineers of the Andhra and the Residuary States.

* * * *

The distribution of Chief Engineers in the two States are :—

Andhra

Sri L. Venkatakrishna Ayyar	*Irrigation*
Sri J. M. Frederick	*General & Buildings*

Residuary Madras

Sri A. R. Venkatachari	*Special Chief Engineer*
Sri N. Padmanabha Ayyar	*General & Buildings*

* * * *

It will be noticed from the allocation of the Chief Engineers given above that Sri A. R. Venkatachari has since taken service with the Residuary State.

The retirement on reaching the age of superannuation on the tenth of September 1953 (after a service of a little over thirty years) of Sri T. S. Venkatarama Ayyar was another important event during the period. His colleagues and the staff of the P. W. D., got up an elegant function to take leave of this eminent engineer. Bidding farewell to those present, Mr. Venkatarama Ayyar stated that he had done his part truly and well and that in his long service he had received ample co-operation and goodwill from all those who worked with him which he would like to acknowledge on that occasion. In this connection he referred, amongst others, to Sri M. D. Narasimhachariar, Superintending Engineer, Tanjore Circle, Sri K. Harihara Iyer, Designs Engineer and Sri V. Jagannatha Iyengar of the Chief Engineer's Office. Speaking in a humorous vein, he referred to Mathematics as his first

Sri T. S. Venkatarama Ayyar

love ever since his college days and disclosed that he was devoted to Engineering only because it was the "bread giver". He added that as an opportunity had now offered itself for dissociating himself with Engineering, he was not going to think of it any longer. As far as he was concerned he would say "Farewell" to Chepauk, but it would only be a "Good bye" to his friends. They could certainly come round to him in his retirement and they would indeed, be very welcome if they wished to

discuss "Mathematics" with him. On the other hand, if they were confronted with a problem in Engineering, he would whole heartedly commend them to Sri L. Venkatakrishna Ayyar.

The "Era" with which he has been associated during his tenure of office as an "Associate Editor" desires to convey its high regards and conveys its good wishes to him for a long and happy life in his retirement.

* * * *

Sri K. Padmanabha Pillai, Special Grade Executive Engineer recently associated with the Tungabhadra Project, has joined the Hirakud Project as Superintending Engineer, for assisting Sri M. S. Thirumale Iyengar, Retired Chief Engineer of P. W. D., who is the Chief Engineer of this Project. A send off to Sri K. Padmanabha Pillai was accorded at Chepauk in September last and this occasion was also availed of to bid good bye to Sri K. Varada Iyengar, another member of the Tungabhadra Staff, who was proceeding on leave preparatory to retirement.

* * * *

Sri M. K. Narambunathan Pillai and Sri C. V. S. Narasimha Rao, Special Grade Executive Engineers were promoted as Superintending Engineers.

* * * *

Sri K. V. Ekambaram, Designs Engineer took part in the Symposium on "Reinforced Concrete in India today" held at Roorkee in November 1953.

At the Indian Standard Institution meeting of the Puzzolona Sectional Committee held at Bombay in August 1953, Sri K. Harihara Iyer (then Designs Engineer and now Deputy Chief Engineer-Buildings and Public Health) was nominated as convenor of the Sub Committee on "Surki as Puzzolona."

* * * *

There has been no response at all to the feature "How would you do it" appearing in the previous issues of the Era on which comments and alternative solutions were called for by the Editor. This is a feature intended to stimulate interest amongst the Engineers and also to serve as a forum for exchange of ideas gathered during their service. It is, therefore, requested that this feature may be helped by contributions in the future.

In order to lend this series a homely touch, a baffling problem which was solved by Sri A. Srinivasan, Executive Engineer, Lower Bhavani Project Headworks Division will be posed in the next issue, instead of extracting these problems, as usual, from foreign journals.

The solution to the problem will be purposely carried over to the subsequent issue for evoking interest amongst the readers and giving them time to send in their solutions to the problem.

* * * *

The "Ourselves", of the last issue concluded with an appeal for articles from members in the Andhra State. This appeal is again renewed as the "Era" proposes to perform the common service of imparting technical information and discussing current trends in Engineering technique for the benefit of members in the two States.

Members in the Residuary State are also requested to contribute articles and make this journal "of the Members, by the Members, for the Members" a real success.

Explanatory Notes for the representations on the opposite page:–

The back cover page of the last issue of the Era, featured "The Important Rivers in the Madras Presidency and their Ayacuts ".

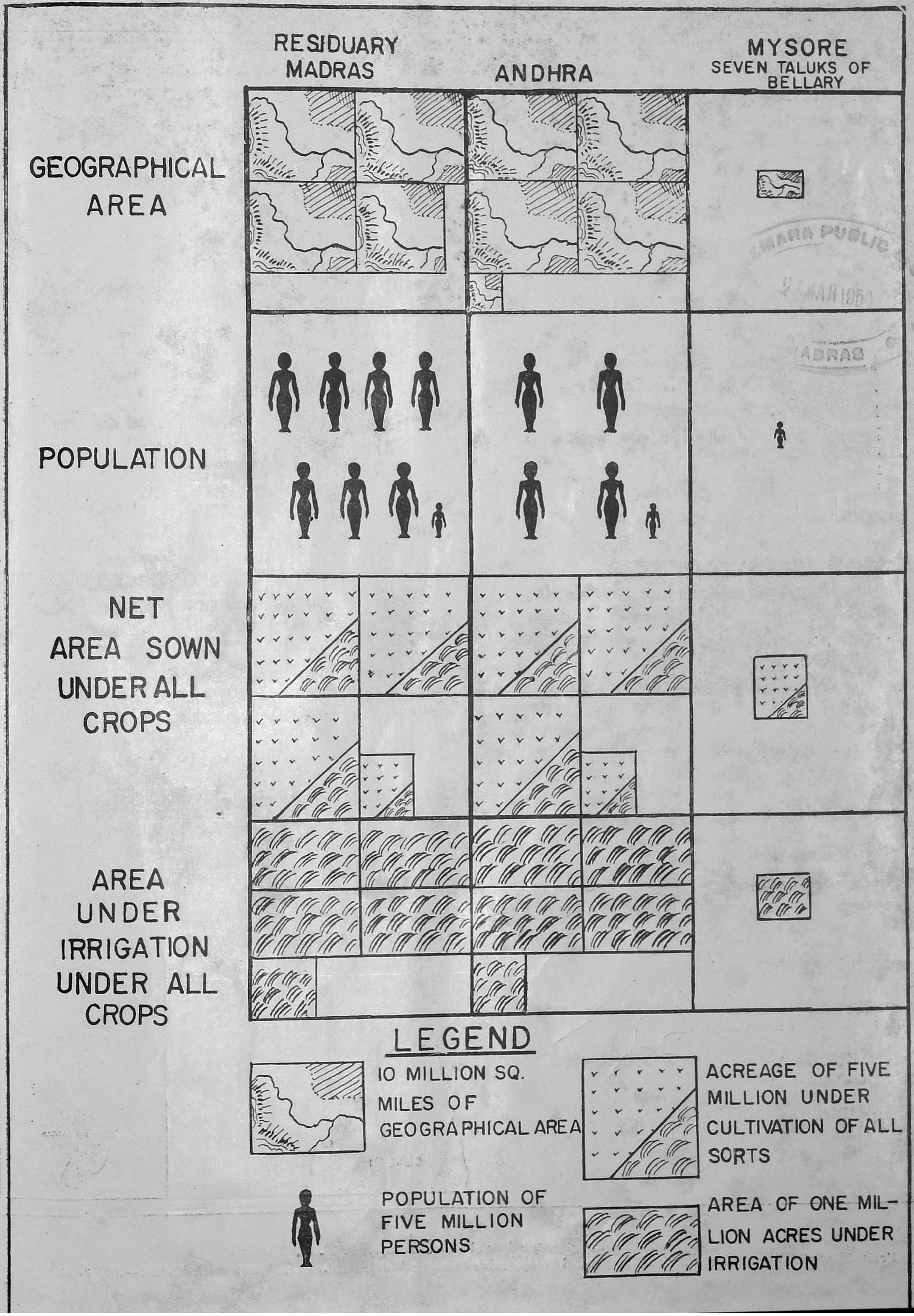
Since then, the Andhra State has been inaugurated and the back cover page of this issue furnishes pictorial representations of the ***" Statistics of certain sailent features in the different States of the composite Madras State, after partition."***

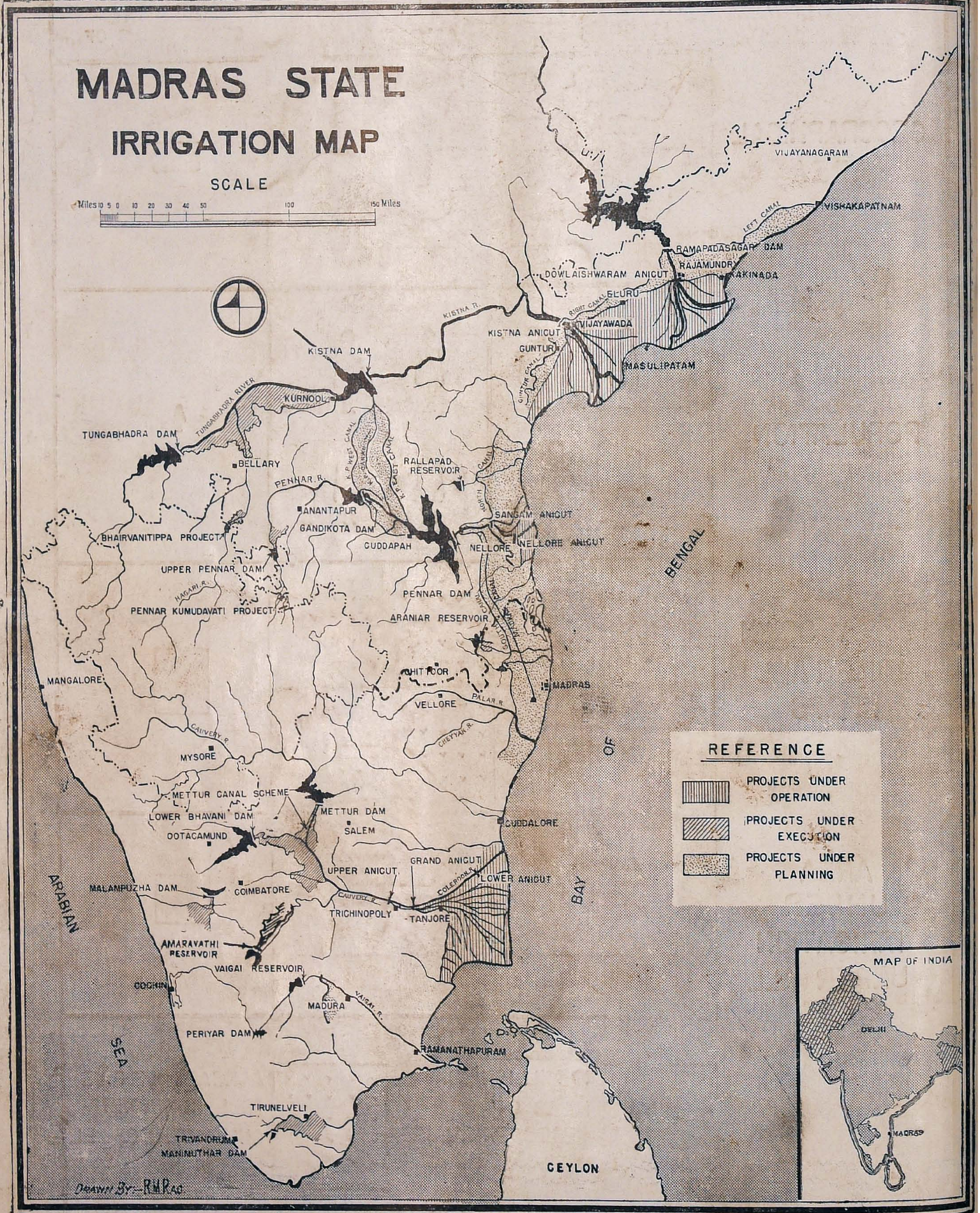
The following tabular statement gives the comparative particulars which are also expressed in percentages on the total of the composite State.

PARTICULARS	Composite State *	MADRAS STATES					
		MADRAS* (Residuary)		ANDHRA *		MYSORE *†	
	Total	Sub-Total	Percentage	Sub-Total	Percentage	Sub-Total	Percentage
1. Geographical Area	81.55	33.52	47.2	40.58	49.8	2.45	3.0
2. Population	57.02	35 73	62.7	20.53	36.0	0.76	1.3
3. Net area sown under all crops	32.57	15.56	47.75	15.62	47.95	1.39	3.0
4. Net area irrigated under all crops.	9.38	4.78	50.90	4.56	48.73	0.34	0.37

* Figures are in millions.

† Seven taluks of Bellary which have been merged with Mysore


RESIDUARY MADRAS
ANDHRA
MYSORE
SEVEN TALUKS OF BELLARY
GEOGRAPHICAL AREA
POPULATION
NET AREA SOWN UNDER ALL CROPS
AREA UNDER IRRIGATION UNDER ALL CROPS
LEGEND
10 MILLION SQ. MILES OF GEOGRAPHICAL AREA
ACREAGE OF FIVE MILLION UNDER CULTIVATION OF ALL SORTS
POPULATION OF FIVE MILLION PERSONS
AREA OF ONE MILLION ACRES UNDER IRRIGATION



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